ABSTRACTS OF NORTH AMERICAN GEOLOGY

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings.

The Abstracts will be an additional reference tool but will not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology will be published each year. The Bibliography will include citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are being prepared by use of computer techniques. Each abstract along with its indexing is placed on magnetic tape and entered into a permanent data bank. The material prepared each month will be published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

The abstracts in this issue were prepared by J. P. Albers, D. E. Bruce, Joan R. Clark, W. A. Coban, Georgianna D. Conant, W. C. Culbertson, K. A. Dickinson, R. C. Douglas, J. R. Gill, H. D. Goode, R. E. Grant, Andrew Griscom, Bettie S. Hackman, B. C. Hearn, J. J. Hemley, J. W. Hosterman, B. H. Kent, E. R. Landis, B. F. Leonard, R. A. Loney, Elisabeth S. Loud, S. H. Mamay, E. K. Maughan, Mildred C. Mead, J. F. Mello, A. T. Miesch, D. R. Mullineaux, Virginia S. Neuschel, A. E. Roberts, E. H. Roseboom, E. T. Ruppel, C. A. Sandberg, S. P. Schweinfurth, V. E. Swanson, Dorothy B. Vitaliano, H. C. Wagner, W. S. White, D. H. Whitebread, F. C. Whitmore, Jr., R. E. Wilcox, R. G. Yates, and E-an Zen.

ABSTRACTS

8014 **Agterberg, F. P.** The use of multivariate Markov schemes in petrology: Jour. Geology, v. 74, no. 5, pt. 2, p. 764–785, illus., tables, 1966.

Multivariate observations in a series may be related to each other by a transition matrix. In this way, systematic variations of the multivariate system with distance or time can be described. From the transition matrix, a trend factor may be extracted which denotes the linear combination of the variates which shows most trend. The method is applied to two series of major oxide data from the basaltic rocks of Yellowknife, Canada. The trend factor describes a periodical curve suggesting some long-period fluctuations in chemical composition of the basaltic magma.—Author's abstract

7893 **Ahlrichs, J. L.; Russell, J. R.; Harter, R. D.; Weismiller, R. A.** Infrared spectroscopy of clay mineral systems: Indiana Acad. Sci. Proc. 1965, v. 75, p. 247–255, illus., 1966.

Infrared spectra of clay-mineral systems can separate trioctahedral from dioctahedral, triphormic from diphormic, and minerals with different degrees and types of isomorphous substitution. It can measure degree of hydration of a mineral, observe its surface character and interactions with organic and inorganic reactants, quantitize some clay systems, and indicate the prevalence and kind of amorphous substances present. It is an excellent new tool to complement the X-ray diffraction in clay mineral research.—Authors' summary

7849 **Alabama Geological Survey; Alabama State Oil and Gas Board.** Oil and gas exploration wells in Alabama: Alabama Geol. Survey Map 36, scale about 1 in. to 8 mi. [1966?].

Alabama State Oil and Gas Board. *See* Alabama Geological Survey, 7849

Alfaro, J. F. *See* Keller, J. 7889

8271 **Alonso, Ramón M., Jr.** Construction material resources of the Manatí quadrangle, Puerto Rico: Puerto Rico Dept. Public Works Geol. Inv. Bull. 10, 49 p., illus., table, 1966.

Tertiary rocks in the Manatí quadrangle consist of the Lares Limestone, Cibao Formation, Aguada and Aymamón Limestones and the Camuy Formation. Quaternary deposits are clay, silt, sand, gravel, peat, muck, and organic clays. Materials available for highway construction are sand, limestone, and fill material. Silica sand is used by chinaware and glass industries and for fill material. Some limestone produces coarse aggregate and terrazo chips.—M.C.M.

8172 **Alsop, L. E.** Transmission and reflection of Love waves at a vertical discontinuity: Jour. Geophys. Research, v. 71, no. 16, p. 3969–3984, illus., 1966.

An approximate method for calculating reflection and transmission coefficients for Love waves incident on a vertical discontinuity is developed. This method is applicable to any desired layered structure. The concept of a coupling coefficient between modes on either side of the boundary is introduced. The concept aids in obtaining physical insight into the problem, provided that the particle motions

for the different modes are known. Several idealized discontinuities are considered and the results discussed in some detail.—Author's abstract

8081 **Alterman, Z.; Kornfeld, P.** Effect of a fluid core on propagation of an SH-torque pulse from a point-source in a sphere: Geophysics, v. 31, no. 4, p. 741–763, illus., tables, 1966.

An exact solution is obtained for the displacement of the surface of a sphere consisting of a fluid core and an elastic solid mantle, due to an impulsive SH-torque source. Theoretical seismograms are computed for several distances from a surface source and from a deep source, and are compared with results for a homogeneous sphere. The seismograms show reflected pulses of H-type and of Lg-type, and pulses after diffraction at the core and at the surface. In agreement with observation and as expected by steepest-descent analysis, it is found that the Lg-type pulses start before the ray arrival time. Traveltime and amplitude curves for reflected and diffracted pulses are given.—D.B.V.

7834 **Amsden, Thomas W.** *Microcardinalia protriplesiana* Amsden, a new species of stricklandiid brachiopod, with a discussion on its phylogenetic position: Jour. Paleontology, v. 40, no. 5, p. 1009–1016, illus., 1966.

Microcardinalia protriplesiana Amsden is a new species of Lower Silurian stricklandiid brachiopod from the Blackgum Formation of northeastern Oklahoma. This species is externally similar to *M. triplesiana* (Foerste) but differs in its more primitive brachial-plate structure. The brachial-plate arrangement in the new species is similar to that of *Stricklandia lens progressa* Williams from Llandoverian Cl beds, Carmarthenshire, Wales.—Author's abstract

Anders, Edward. *See* Fitch, F. W. 8149

7969 **Anderson, Orson L.** An approximate method for computing the isotropic sound velocities using refractive index data: Am. Mineralogist, v. 51, no. 7, p. 1001–1013, illus., tables, 1966.

The isotropic sound velocities of phases having oxygen as the dominant anion can be approximately computed at ambient conditions from the chemical compositions and refractive indices. The method is based on the recent observation that for these phases the elastic moduli are functions only of the specific volume, and that the refractive indices obey Drude's law. These simple relations are not obeyed by the alkali halides.—E.Z.

7991 **Andrews, J. T.; Shimizu, K.** Three-dimensional vector technique for analyzing till fabrics—Discussion and Fortran program [with French abs.]: Canada Dept. Mines and Tech. Surveys Geog. Br. Geog. Bull., v. 8, no. 2, p. 151–165, illus., tables, 1966.

A program for a three-dimensional vector analysis of till fabrics is presented for the IBM 1620 and CDC 3100 computer series. Three till samples were studied and analyzed by various methods. The samples all belong to the same till unit but the preferred orientation of their 'a' axes varies considerably within a 3-metre vertical section. Absence of a marked surface of accumulation or a bedding plane within till sheets may result in till fabrics with apparent orthorhombic symmetry if the horizontal plane is used to determine the sense of direction. Selection of other reference planes may show a general unimodal or monoclinic symmetry, i. e., a spherical-normal distribution. Special problems can result because of pebbles lying transverse, i. e., in the 'B' lineation, but these distributions can be analyzed separately.—*from* Authors' abstract

8051 **Andrews, J. T.** Pattern of coastal uplift and deglacierization, west Baffin Island, N.W.T. [with French abs.]: Canada Dept. Mines and Tech. Surveys Geog. Br. Geog. Bull., v. 8, no. 2, p. 174–193, illus., tables, 1966.

The marine limit in the Grant-Suttie Bay—Isortoq Fiord area is a major strandline formed in association with the Isortoq Phase moraines and established, according to radiocarbon dating, less than 7,000 years ago. Subsequent offshore updoming

resulted in an upward tilt of the area toward S. 35° W. at the rate of 1.0 metre km. A lower strandline at about 20 metres above sea level was formed less than 4,000 years ago. Uplift of the west coast of Baffin Island has been slow compared to adjacent glacial dispersal zones. It is suggested that this relates in part to the dampening effect of Baffin Island ice cap which was of major proportions during the initial rebound period. Rates of uplift are compared from both sides of the Foxe Basin and found to differ.—Author's abstract

7809 **Andrichuk, J. N.; Edie, R. W.** Plenty of reefs still outside Rainbow: Oil and Gas Jour., v. 64, no. 43, p. 152–156, 1966.

A 240-acre oil field was found on a Devonian pinnacle reef in the Leduc Formation at Morinville, near Edmonton, Alberta. Detailed stratigraphic studies were necessary to find this field, and it probably will be necessary for operators in the future to drill several stratigraphic test wells to find similar fields. The discovery well was the third well drilled in the relatively small prospect area. Seismic work over a period of 17 years failed to delineate the Morinville field. The total primary recoverable oil reserves in the field is 10,020,000 barrels.—K.A.D.

7981 **Arnold, R. G.** Mixtures of hexagonal and monoclinic pyrrhotite and the measurement of the metal content of pyrrhotite by X-ray diffraction: Am. Mineralogist, v. 51, no. 7, p. 1221–1227, illus., table, 1966.

The d_{102} versus composition relation for natural pyrrhotites for which suitable material was available was re-examined after the discovery of intergrowths of coexisting monoclinic and hexagonal pyrrhotite on etched polished surfaces of these pyrrhotites. A curve thru the new points is about 0.2 atomic percent richer in iron than the original experimental curve.—E.H.R.

8265 **Asquith, D. O.** Geology of Late Cretaceous Mesaverde and Paleocene Fort Union oil production, Birch Creek unit, Sublette County, Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2176–2184, illus., 1966.

The Mesaverde and upper Hilliard Formations form a regressive sequence, from northwest to southeast, of lagoonal coal-bearing siltstone and thick sandstone beds, a littoral sandstone complex, and a sequence of marine siltstone and shale. Truncated, upturned littoral sandstone beds at the Late Cretaceous–Paleocene unconformity, lateral permeability changes, and the gentle structure of the La Barge arch, together form the traps within the Mesaverde Formation. The major part (Fort Union Formation) of the basal Paleocene rocks forms a regressive lacustrine sequence of lacustrine shale; marginal-lacustrine sandstone; paludal shale, siltstone, and thin sandstone; and variegated mudstone and thick sandstone probably deposited in a fluvial environment. Traps are formed as a result of updip and lateral pinchouts of individual sandstone bodies into lacustrine shale along the east flank and crest of La Barge arch.—W.C.C.

8255 **Auffenberg, Walter.** A new species of Pliocene tortoise, genus *Geochelone*, from Florida: Jour. Paleontology, v. 40, no. 4, p. 877–882, illus., 1966.

A new species of land tortoise, *Geochelone (Hesperotestudo) alleni*, is described from the Hemphillian faunal zone of late middle Pliocene age of Florida. *G. alleni* is clearly a member of the *turgida* group and is most closely related to *G. incisa* of the Pleistocene Series of Florida.—Author's abstract

7948 **Aumento, F.** Stability, lattice parameters, and thermal expansion of β-cristobalite: Am. Mineralogist, v. 51, no. 7, p. 1167–1176, illus., tables, 1966.

β cristobalite was synthesized on heating the zeolite stilbite beyond 920°C. Precise determination of the resultant cell parameters at room temperature has shown that the latter are dependent on previous thermal history: the lattice parameter "a" is inversely proportional to the maximum temperature of the annealment. The thermal expansion characteristics of a sample previously heated to 1400°C indicate that a maximum cell volume exists at 1000°C. The linear thermal expansion coefficient is 10.9×10^{-6} $\Delta L/L/°C$ for the range 100°C to 500°C, decreasing to 1.7×10^{-6} between 500°C and 1000°C.—*from* Author's abstract

8045 **Aumento, F.** Zeolite minerals, Nova Scotia [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 71–78, illus., 1966.

The zeolites occur in amygdaloidal pipes in the Triassic basalts, pipes probably formed by steam and gases released at the base of the flows as they poured onto wet sediments or shallow lakes. Abundant zeolites are stilbite, heulandite, analcite, apophyllite, and laumontite; less abundant, chabazite and natrolite; rare, gmelinite, mesolite, mordenite, scolecite, and thomsonite. All are described, eight are illustrated, and a map shows their distribution.—E.S.L.

8186 **Baars, D. L.** Pre-Pennsylvanian paleotectonics—Key to basin evolution and petroleum occurrences in Paradox basin, Utah and Colorado: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2082–2111, illus., 1966.

The large northwest-trending graben-faulted anticline consisting of late Precambrian through Mississippian rocks exposed in the core of the San Juan Mountains near Silverton, Colorado, formed before Late Cambrian and was intermittently active into the Pennsylvanian. This structure may be considered an exposed segment of the southeastern Paradox basin and a reference to aid in understanding the basin. Sedimentation from Late Cambrian to Pennsylvanian and post-Pennsylvanian salt tectonics were all affected by the preliminary faulted structure. Pre-Pennsylvanian reservoir facies were best developed high on upthrown fault blocks. These are Late Devonian sand bars and Early Mississippian biogenic crinoid banks.—S.P.S.

Bagnold, R. A. *See* Smith, W. O. 7886

Bailey, S. W. *See* Shirozu, Haruo. 7974

Bailey, S. W. *See* Eggleton, R. A. 8107

Bailey, S. W. *See* Bradley, W. F. 8142

Bales, James D. *See* Clark, Robert T. 7811

7851 **Ballard, James A.** Structure of the lower continental rise hills of the western North Atlantic: Geophysics, v. 31, no. 3, p. 506–523, illus., 1966.

New information on the movement and deposition of sediments on the ocean floor has been provided by recent reflection surveys of part of the western North Atlantic. Progressive gravitational gliding explains the features observed on the various profiles. Structural and topographic anomalies of the lower rise hills and of the conditions required for gravitational gliding permit speculation about the sequence of events leading to their origin.—D.B.V.

8231 **Banks, Philip O.; Silver, Leon T.** Evaluation of the decay constant of uranium 235 from lead isotope ratios: Jour. Geophys. Research, v. 71, no. 16, p. 4037–4046, illus., tables, 1966.

The U-235 decay constant has been evaluated from radiogenic Pb-207/Pb-206 ratios of cogenetic fractions of zircon and uranothorite. Variations in Pb-206/U-238 apparent ages indicate some form of isotopic disturbance during the geologic history. The method of calculating λ_{235} is shown to be relatively insensitive to this disturbance. Inaccuracy in the calculated value is further reduced by deducing probable limits to apparent ages from geologic and isotopic conditions. The results suggest that the currently accepted value of λ_{235} is probably accurate to within 1 percent relative to the accepted values of λ_{238} and the isotopic composition of natural uranium.—D.B.V.

8181 **Barlow, James A., Jr.; Haun, John D.** Regional stratigraphy of Frontier Formation and relation to Salt Creek field, Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2185–2196, illus., 1966.

The Frontier Formation and equivalent sediments were deposited in, or on the margins of, a shallow sea which covered the Western Interior region during the Cenomanian and Turonian stages of the Late Cretaceous. Most of the oil production at the Salt Creek field is from lenticular sand bodies in the Frontier. These sand bodies are interpreted as offshore bars.—A.E.R.

7997 **Barnard, Walther M.; Christopher, Peter A.** Further study on the effectiveness of aqueous solutions in the hydrothermal synthesis of chalcopyrite: Econ. Geology, v. 61, no. 7, p. 1287–1290, table, 1966.

Chalcopyrite can be dissolved at the hotter end and recrystallized at the cooler end of a reaction vessel in the presence of certain solvents in the general range 400°–450°C. Chloride solutions are effective, particularly ammonium chloride. Syntheses may take place with NaHS and ammonium hydroxide.—W.S.W.

Barnes, Harley. *See* Stewart, John H. 7771

Barnes, Harley. *See* Christiansen, Robert L. 7775

8019 **Barnes, Hubert L.; Scott, S. D.** Stoichiometry of sulfide minerals [abs.]: Econ. Geology, v. 61, no. 7, p. 1297, 1966.

8252 **Barnes, Virgil E.; Boucot, Arthur J.; Cloud, Preston E., Jr.; Miller, Richard H.; Palmer, A. R.** Silurian of central Texas—A first record for the region: Science, v. 154, no. 3752, p. 1007–1008, illus., table, 1966.

Silurian outcrops, not previously recorded from central Texas, have been identified from the Llano uplift, where they occur in collapse structures within the Lower Ordovician Honeycut Formation of the Ellenburger Group. The formation is a pinkish-gray granular limestone, contains fossils of probable Wenlock age, and is named the Starcke Limestone.—Authors' abstract

8003 **Barry, G. S.** Point counting as a method of assaying wolframite at Story's Creek Mine, Tasmania [discussion of paper by M. Solomon and C. Brooks, 1966]: Econ. Geology, v. 61, no. 7, p. 1293, 1966.

A technique similar to that described by Solomon and Brooks (ibid., v. 61, p. 376–384) was used in 1955 to evaluate a wolframite vein at Grey River, Newfoundland.—W.S.W.

8017 **Barton Paul B. Jr.; Skinner Brian J.** Reaction points of possible interest in geothermometry studies of ore deposits [abs.]: Econ. Geology, v. 61, no. 7, p. 1296, 1966.

Barton, Paul B., Jr. *See* Toulmin, Priestley, 3d. 8020

7824 **Baskerville, Charles Alexander.** A micropaleontological study of Cretaceous sediments on Staten Island, New York [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 517B, 1966.

Bauer, W. R. *See* Rex, R. W. 8124

8168 **Bayer, T. N.** *Astylospongia* from the Maquoketa Formation in Minnesota: Jour. Paleontology, v. 40, no. 6, p. 1387–1388, illus., 1966.

Sixty-seven specimens of *Astylospongia* cf. *A. praemorsa* (Goldfuss) were collected from the surface of a single weathered outcrop of the Elgin Member of the Maquoketa Formation (Upper Ordovician). This is the first report of a lithistid sponge from the Ordovician rocks of the upper Mississippi Valley.—R.C.D.

7899 **Bechert, Charles H.; Heckard, John M.** Ground water, *in* Natural features of Indiana—Symposium, 1966 (Indiana Sesquicentennial Volume 1816–1966): Indianapolis, Ind., Indiana Acad. Sci., p. 100–115, illus., tables, 1966.

In addition to a generalized summary of ground-water hydrology, water availability is indicated by provinces referred to numbers on a map. Wells in the various types of aquifers, mostly in glacial drift and underlying limestone, are described briefly as to depth and yield. The minimum recorded flow of springs in 1960 and a representative analysis of ground waters are tabulated. About 12 billion gallons of water are used each day, but with the exception of portions of southern Indiana, there is a bountiful supply; an estimated 100,000 billion gallons are in reserve storage. The quality varies considerably in different parts of the State, but is in general satisfactory for domestic and industrial uses. Water levels have fluctuated considerably since first observed in 1935, but with no continuous downward trend.—G.D.C.

8080 **Becker, Herman F.** Additions to and revision of the Oligocene Ruby Paper Shale flora of southwestern Montana: Michigan Univ. Mus. Paleontology Contr., v. 20, no. 5, p. 89–119, illus., 1966.

Twenty-four species new to the Tertiary record of the Ruby Paper Shale flora are described, including revision of some earlier published material (Becker, 1959 to 1965) and the new species *Pinus drepanogona, Prunus eleanorae, Pyrus rubyensis, Rhus cotinoides. Myrica dorfi* Becker, 1961, is reassigned to *Alnus*. A revised list of the complete flora identifies 99 species and 25 generically determined forms. Relations to the Florissant, Colo., Kilgore, Nebr. (MacGinitie, 1962), and other floras are discussed. Deciduous trees and shrubs are predominant in comparison with gymnosperms and herbaceous plants. Of 40 families in the Ruby flora, the Rosaceae, with 16 percent of all species, is the largest. In all recently discovered species the leaf size is smaller than average, as in the flora as a whole.—*from* Author's abstract

8204 **Bennett, Gerald.** Belford township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P.344, scale 1 in. to 1/2 mi., text, 1966.

The eastern half of Belford township is almost completely covered by glacial lake clay with local deposits of sand and boulder clay. Available evidence indicates the southern and central portions are underlain by a varied assemblage of metavolcanic rocks. The western edge is underlain by acidic to basic gneisses and acidic intrusive rocks; gneisses display prominent banding and are commonly garnetiferous. The marked difference in metamorphic grade between gneisses and volcanic rocks implies a fault contact between them. Very minor amounts of disseminated sulfides are found in gabbro, and sulfides are rarely seen in outcrops of volcanic rocks.—M.C.M.

8205 **Bennett, Gerald.** Montcalm township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P.345, scale 1 in. to 1/2 mi., text, 1966.

Most of Montcalm township is overlain by glacial lake clay and silt. Glaciofluvial deposits of sand occur in the eastern part and along the Groundhog River's west bank. Oldest rocks are altered basic to intermediate volcanic flows and tuffs; volcanic rocks have been intruded by a large mass of gabbro with minor amounts of serpentinite, diorite, and mafic-rich gabbro or pyroxenite. The eastern edge of the township is underlain by massive, grey granite which is younger than the gabbroic intrusive rocks. Matachewan diabase dikes cutting all the above rocks are quartz diabase and consistently strike approximately north-south. No significant amounts of economic minerals have been found.—M.C.M.

8206 **Bennett, Gerald.** Nova township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P.346, scale 1 in. to 1/2 mi., text, 1966.

A great portion of Nova township is covered by glacial lake clay and silt. In the southeastern part sand deposits are common and two large eskers are present. The eastern half is underlain mostly by basic to intermediate volcanic flows and intermediate tuffs. The few outcrops along the western boundary indicate the underlying rocks are predominantly granitic intrusions. Between the eastern and western sections a broad belt of acidic volcanic rocks may contain some intercalated sedimentary rocks. A sill-like intrusion of gabbro cuts the northeastern part and Matachewan diabase dikes the eastern part. Faulting to the west is believed to

be a continuation of that in Belford township. The only economic minerals visible in a core sample are minor amounts of sphalerite.—M.C.M.

Berg, Joseph W., Jr. *See* Cook, Kenneth L. 7831

Berger, Fred E. *See* Pfleider, Eugene P. 8053

8250 **Berger, Rainer; Taylor, R. E.; Libby, W. F.** Radiocarbon content of marine shells from the California and Mexican west coast: Science, v. 153, no. 3738, p. 864–866, illus., tables, 1966.

The radiocarbon content of contemporary pre bomb marine shells from the upwelling environment of the California and the West Mexican coast has been determined. In addition, factors leading to the apparent ages of different magnitude for various marine environments are discussed.—Authors' abstract

7895 **Berrangé, Jevan P.** The bedrock geology of Vatnahverfi, Julianehåb district, South Greenland: Grønlands Geol. Undersøgelse Rap. 3, 48 p., illus., tables, geol. maps, 1966.

Petrology, structure, and chronology of the 300 sq km area are described. All rocks are Precambrian. The Ketilidian period is represented by a migmatite complex of biotite and hornblende gneisses showing relict supracrustal structures and intermingled with foliated granites. Mapping and stereographic structural analysis show that the complex was initially folded about NE trending B1 axes and subsequently on vertical to NW trending B2 axes. The Kuanitic period is represented by discordant dolerite and microdiorite dykes and hornblende gabbro plutons. Renewed plutonism during the Sanerutian period caused local reactivation of the Julianehåb granite. Synplutonic amphibolite dykes and sheets were intruded. A discordant batholith and sheets of biotite adamellite were emplaced. The Gardar period is represented by faulting, mineralization, and dolerite, trachyte, and alkali trachyte dykes.—*from* Author's abstract

7813 **Berry, E. G.; Miller, B. B.** A new Pleistocene fauna and a new species of *Biomphalaria* (Basommatophora: Planorbidae) from southwestern Kansas, U.S.A. [with Spanish and Russian abs.]: Malacologia, v. 4, no. 1, p. 261–267, illus., 1966.

A new Pleistocene assemblage, the Spring Creek local fauna, is reported from the Aftonian of southwestern Kansas. The fauna contains 16 species of gastropods, including *Biomphalaria kansasensis* Berry, sp. n. The habitats, inferred from the molluscan assemblage consist of temporary pools which were probably surrounded by high grass and some scattered shrubs and trees. The climate at the time the fauna lived was probably semiarid, combining summers that were less hot with winters that were considerably warmer than those of the present. The average annual precipitation in this area was similar to the present in terms of seasonal distribution and amount. However, the higher evapotranspiration rates during the warmer winter months would tend to produce a drier climate.—Authors' abstract

8169 **Berry, W. B. N.** *Orthograptus truncatus richmondensis* (Ruedemann) in the Arnheim Formation (Ordovician) in Indiana: Jour. Paleontology, v. 40, no. 6, p. 1392–1394, illus., 1966.

Graptolites are not common in shell-rich, fossil-bearing beds. Numerous specimens of *Orthograptus* were found associated with the brachiopods *Rafinesquina* and *Dinorthis* and with the pelecypod *Pterinea*.—R.C.D.

8061 **Berven, R. J.** Cardium sandstone bodies, Crossfield-Garrington area, Alberta: Bull. Canadian Petroleum Geology, v. 14, no. 2, p. 208–240, 1966.

The oil-producing Cardium Formation of the Crossfield-Garrington area, south-central Alberta, consists of two and locally three marine sandstone members separated by marine shale. The lower member consists of two lenticular sandstone masses called the Crossfield and the Garrington sandstone bodies. The Crossfield trends northwest-southeast, is 60 miles long, 1 to 2 1/2 miles wide, and attains a thickness of 20 feet. It has a gradational lower and a sharp upper contact, is

lenticular in cross section having a flat bottom and a concave upper surface. It was deposited parallel to the western shore of the Turonian (early Late Cretaceous) seaway and it is interpreted to be an offshore bar. The Garrington sandstone body appears to be a stratigraphic equivalent to the Crossfield but deposited several miles seaward from it. Oil is produced from both sandstone bodies.—J.R.G.

7933 **Bieber, C. L.** Fossil algae in the St. Louis limestone of western Indiana: Indiana Acad. Sci. Proc. 1965, v. 75, p. 206–209, illus., 1966.

Nodules of a uniform biscuit-like shape, showing a microstructure of tubes peculiar to some fossil algae are examined, and those collected from a representative site at Vermillion Falls, Ind., are described. These structures have recently been placed in the family Codiaceae, and may be a mixture of genera. Other questionable fucoidal and stromatolitic structures are listed, and the Mississippian shallow-sea paleoecology described. Some genera, like *Ortonella* are useful in stratigraphic studies.—E.S.L.

8209 **Billings Geological Society.** (compiler). Selected bibliography of stratigraphy in Montana and adjacent areas: Montana Bur. Mines and Geology Spec. Pub. 38, 61 p., 1966.

8178 **Biot, M. A.; Odé, H.** Reply to discussion by M. D. Outmans [of "Theory of gravity instability with variable overburden and compaction", 1965]: Geophysics, v. 31, no. 4, p. 830–831, 1966.

In answer to Outmans' objection (ibid., v. 31, no. 4, p. 829–830, 1966), the difference between flow for a solid and that for a liquid is examined. The question whether the treatment assuming purely Newtonian viscosities for incremental strains is better or worse than a more involved one is premature, as the constitutive equations of most rock materials are largely unknown. The treatment in question may be considered a first approximation based on a reasonable assumption. It applies only to the first phase of instability when the slopes of the salt structure remain small and no faulting appears in the shale.—D.B.V.

7844 **Bisal, F.; Hsieh, J.** Influence of moisture on erodibility of soil by wind: Soil Sci., v. 102, no. 3, p. 143–146, illus., 1966.

There is a difference in the percent moisture required to effectively prevent initiation of movement in different types of soil. The small amount of moisture required to make a soil resistant to movement by winds can be removed in a very short interval of time, causing the soil to be highly erosive if it is within the erosive size range. The wind velocity required to initiate soil movement is similar for fine sandy loam and loam containing about 3.5 percent moisture and clay containing about 11.0 percent moisture.—J.W.H.

7786 **Bishop, Bobby Arnold.** Stratigraphy and carbonate petrography of the Sierra de Picachos and vicinity, Nuevo León, Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 517B–518B, 1966.

Black, C. A. *See* Chaverri, J. G. 7962

Blakey, J. F. *See* Smith, J. T. 8258

8030 **Bleifuss, Rodney L.** Origin of the brown iron ores of southeastern Minnesota and their relation to the Cretaceous Windrow Formation of the upper Mississippi Valley region [abs.]: Econ. Geology, v. 61, no. 7, p. 1306–1307, 1966.

8154 **Boardman, R. S.; Utgaard, John.** A revision of the Ordovician bryozoan genera *Monticulipora, Peronopora, Heterotrypa, and Dekayia*: Jour. Paleontology, v. 40, no. 5, p. 1082–1108, illus., 1966.

A restudy of type specimens of the type species and related species, and a reevaluation of nomenclatorial problems, provide new information and revised concepts for the trepostome bryozoan genera listed in the title. Detailed anatomical and morphological descriptions are augmented by idealized cutaway diagrams,

scatter diagrams of measured or counted characters, and detailed photomicrographs.—R.C.D.

7902 **Bödvarsson, Gunnar.** Direct interpretation methods in applied geophysics: Geoexploration, v. 4, no. 3, p. 113–138, illus., table, 1966.

In contrast to master curves and other trial-and-error processes, methods of interpreting geophysical data are based on more direct computational procedures. Their usefulness is emphasized, and it is shown that they are closely related to methods of electrical network synthesis. The driving point exploration and synthesis of linear parameter ladders on the basis of continued fraction expansion is shown in detail. An analogous procedure is applied to systems with distributed parameters. Examples of equivalent results by driving point synthesis are shown in the interpretation of d–c conduction and magnetotelluric data obtained in the case of a horizontally stratified Earth. Formal solutions of the synthesis problems involved are given, and further geophysical cases are discussed.—G.D.C.

8266 **Bolyard, Dudley W.; McGregor, Alexander A.** Stratigraphy and petroleum potential of Lower Cretaceous Inyan Kara Group in northeastern Wyoming, southeastern Montana, and western South Dakota: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2221–2244, illus., 1966.

The Inyan Kara group, composed of Lakota and Fall River Formations, consists of sandstone, shale, conglomerate, variegated siltstone, and claystone and forms the lower part of the Cretaceous in the Black Hills and adjacent areas. The Lakota is dominantly continental and the Fall River is deltaic and other marginal marine deposits, littoral to neritic sandstone, and offshore shale deposited during a southwestward transgression of the Cretaceous sea. Variations in thickness and facies of these two formations are explained by the encroachment of the sea and the shifting of the delta along its margin. Most oil is trapped in sandstone reservoirs behind updip permeability barriers. The sand is believed to have been deposited in meandering channels which are approximately parallel with present-day structural contours.—E.K.M.

8046 **Borns, Harold W., Jr.; Swift, Donald J. P.** Surficial geology, north shore of Minas Basin, Nova Scotia [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 81–85, illus., 1966.

The last ice sheet to cover northern Nova Scotia advanced from the northwest. It dissipated by thinning, by separation over the Cobequid Mountains, and, finally, by stagnation immediately south of the Cobequids. Meltwater from the dissipating ice deposited extensive valley trains, alluvial fans, and marine deltas in the area between the Cobequid Mountains and Minas Basin. Today, the fans and deltas form a raised terrace whose top surface slopes eastward.—Authors abstract

7960 **Boström, Kurt; Fredriksson, Kurt.** Surface conditions of the Orgueil meteorite parent body as indicated by mineral associations: Smithsonian Misc. Colln., v. 151, no. 3 (Smithsonian Inst. Pub. 4667), 39 p., illus., tables, 1966.

Three main periods of mineral formation can be recognized in the Orgueil meteorite: an early stage with minerals like troilite, stable at several hundred degrees centigrade; a middle stage with minerals like chlorite and limonite formed below 170°C; and a late stage with carbonates and sulfates formed below 50°C. A physico-chemical analysis of the mineral-forming conditions indicates that oxidized phases like sulphate and limonite cannot be formed as a result of local equilibrium but need an external source of oxidation. None of the volatiles that may emanate from inside the parent body can oxidize troilite to these minerals; possibly water at the surface was dissociated by ultraviolet light, the lighter hydrogen escaped, and some of the oxygen reacted with solid phases on the surface of the parent body.—G.D.C.

7990 **Bottino, Michael L.; Fullagar, Paul D.** Whole-rock rubidium-strontium age of the Silurian-Devonian boundary in northeastern North America: Geol. Soc. America Bull., v. 77, no. 10, p. 1167–1175, illus., tables, 1966.

Nine whole-rock samples of the Skala age volcanic rocks from the Eastport Formation, Eastport, Maine, and nine whole-rock samples of Lower Devonian volcanic rocks from the Hedgehog Formation, Presque Isle, Maine, were analyzed for their rubidium, strontium, and strontium isotope composition. The combined results give an age of 413±5 m.y. for the Silurian–Devonian boundary, which is in reasonable agreement with recent time-scale estimates considering the uncertainty of the Rb-87 decay constant.—J.P.A.

7829 **Boucot, A. J.; Johnson, J. G.** *Lissocoelina* and its homeomorph *Plicocoelina* n. gen. (Silurian, Pentameracea): Jour. Paleontology, v. 40, no. 5, p. 1037–1042, illus., 1966.

Brachiopod genus *Lissocoelina* Schuchert and Cooper, 1931, type species *Pentamerus pergibbosus* Hall and Whitfield, 1875, contrary to the condition implicit in its name, bears low radial plications anteriorly. It may be distinguished from true *Conchidium* and its homeomorphs by the form of the valves. Examination of *Pentamerus pesovis* Whitfield, *Conchidium obsoletum* Hall and Clarke, and *C. occidentalis* (Hall) leads to the conclusion that the last is a senior synonym inclusive of the other two. *Conchidium occidentalis* is made type species of a new genus *Plicocoelina*, a homeomorph of *Lissocoelina* bearing internal structures like those of *Conchidium biloculare*.—*from* Authors' abstract

7837 **Boucot, A. J.; Gauri, K. L.** *Quadrikentron* (Brachiopoda) a new subgenus of *Strophochonetes*: Jour. Paleontology, v. 40, no. 5, p. 1023–1026, illus., 1966.

A new subgenus *Strophochonetes (Quadrikentron)* is based on *Chonetes hudsonica camdenensis*. The species *"Chonetes" hudsonicus* and *"Chonetes" hudsonicus camdenensis* are revised and assigned to the new subgenus. The new subgenus is known from the Early Devonian Appalachian Province [New York, Tennessee] in strata of Oriskany and Schoharie age. *Strophochonetes (Quadrikentron)* differs from *Strophochonetes (Strophochonetes)* chiefly in the nature of its dental sockets and certain other features of its cardinalia.—Authors' abstract

Boucot, A. J. *See* Ziegler, A. M. 7860

8171 **Boucot, A. J.; Johnson, J. G.; Struve, Wolfgang.** *Stringocephalus*, ontogeny and distribution: Jour. Paleontology, v. 40, no. 6, p. 1349–1364, illus., 1966.

A growth series of the brachiopod *Stringocephalus*, represented by silicified specimens from Devonian rocks of southern Nevada, includes a small stage characterized by a rudimentary cardinal process formed as a tonguelike extension of the posterior of the brachial valve. Median septa are absent from the smallest specimens, and crural plates are absent from all specimens. Thus the youngest growth stage fails to mimic either earlier genera such as *Subrensselandia* or morphologically simpler genera such as *Rensselandia, Bornhardtina, Geranocephalus*. Review of *Stringocephalus* distribution indicates that the genus is widespread in the Old World from western Australia and Asia to North Africa, western Europe, and southern England. Many reports of the genus are noted in western Canada and in the western United States, and recently in Indiana.—*from* Authors' abstract

Boucot, Arthur J. *See* Barnes, Virgil E. 8252

7859 **Bowen, Zeddie Paul.** Intraspecific variation in the brachial cardinalia of *Atrypa reticularis*: Jour. Paleontology, v. 40, no. 5, p. 1017–1022, illus., 1966.

Specimens of *Atrypa reticularis* with abnormal structures in the brachial valve, consisting of a massive deposit in the notothyrial cavity, have been found with normal shells in the Keyser and New Creek Limestones and Rondout Formation [Silurian, Appalachians, New York to Virginia]. A complete gradation exists between the normal and abnormal shells, and they are judged to represent intraspecific variation. The ratio of these shells varies in different rock types; the association of the abnormal shells primarily with rocks indicating a moderately high environmental energy level and of the normal shells with rocks indicating a lower environmental energy level suggests that the feature is an adaptation to agitated water conditions. The aberrant deposit probably functioned as a stabilizing and

orienting posterior weight and a strengthening buttress to the socket walls. Author's abstract

7862 **Bowen, Zeddie Paul.** Brachiopods and stratigraphy of the Elbow Ridge Sandstone (Lower Devonian) of Pennsylvania, Maryland, and West Virginia: Jour. Paleontology, v. 40, no. 5, p. 1051–1062, illus., 1966.

Twelve species of articulate brachiopods are described from the Elbow Ridge Sandstone of Pennsylvania, Maryland and West Virginia. The sandstone is interpreted as a beach or bar sand facies, and the fossil assemblage is transported and sorted death assemblage. The formation is correlated with the Lower Devonian (Gedinnian) Kalkberg Formation of New York, and the New Creek Limestone of western Maryland. The name Elbow Ridge Sandstone is formally proposed for the unit, and use of the name "Coeymans Sandstone" for these rocks is discouraged.—Author's abstract

8142 **Bradley, W. F.; Bailey, S. W.** (editors). Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), 453 p., illus., tables, 1966.

The volume contains 31 papers and 7 abstracts, of which 10 comprise a symposium on structural aspects of layer silicates. An appendix gives a report on the work of the Nomenclature and Liaison Committee of the Clay Mineral Society, 1963–64. An author-subject index is included.—E.S.L.

7767 **Branson, Carl C.** Sole marks in Atoka rocks of platform facies: Oklahoma Geology Notes, v. 26, no. 9, p. 236–239, illus., 1966.

Molds and impressions of segmented organisms occur in Atoka siltstones and sandstones of Sequoyah, Cherokee, and Muskogee Counties, Okla. A new species, *Scalarituba? atoka*, is illustrated and described. It occurs as uniformly segmented tubular traces of a bottom-dwelling organism. The segments are hemispherical, concave at one end, and separated by narrow interspaces. The tubes were probably feeding burrows of an annelid. Caudagalli structures, or rooster-tail marks, occur in several horizons of Atoka sandstones. A brief history of their taxonomy is given. The authors advise against formal taxonomic treatment and conclude that they are sedimentary structures with no organic relationships.—B.S.H.

Bremser, Shirley M. *See* White, W. Arthur. 8215

8036 **Brett, Robin; Kullerud, Gunnar.** Melting relationships of galena-pyrite-pyrrhotite assemblages—A homogeneous sulfide melt at 718°C [abs.]: Econ. Geology, v. 61, no. 7, p. 1302, 1966.

Briggs, Louis I. *See* Webb, William M. 8009

8116 **Brindley, G. W.** (chairman). Report . . . of the Nomenclature and Liaison Committee of the Clay Minerals Society, 1963–4, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 429–432, table, 1966.

This report is summarized in a table with notes. The basis for the clay-mineral classification scheme is that a classification cannot be developed independently of a classification of layer silicates. Therefore the scheme contains minerals not normally regarded as clay minerals (e.g. margarite) and omits some commonly used clay-mineral terms because of lack of adequate definition at the present time, or because they do not fall within this scheme.—E.S.L.

Brindley, G. W. *See* Harward, M. E. 8137

7958 **Broeker, Margaret E.; Winslow, John D.** Ground-water levels in observation wells in Kansas, 1965: Kansas Geol. Survey Bull. 184, 92 p., illus., tables, 1966.

Measurements of water levels in 886 wells in 75 counties in Kansas during 1965 are given in this report, the tenth in a series of annual water-level reports published by the State Geological Survey of Kansas. Ground-water levels, in general, had relatively little net change or rose slightly in response to above-normal precipitation over the State. The above-normal precipitation coupled with a reduction in the extensive use of ground-water for irrigation helped to stabilize or reduce the rate of decline of water levels in irrigation areas.—Authors' abstract

8195 **Broom, M. E.; Myers, B. N.** Ground-water resources of Harrison County, Texas: Texas Water Devel. Board Rept. 27, 73 p., illus., tables, 1966.

The geologic units that are the principal source of water in Harrison County consist of the Wilcox Group, the Carrizo Sand, the Reklaw Formation, and the Queen City Sand, all of Eocene age. These units are hydraulically interconnected and function as a single aquifer known as the Cypress aquifer. The aquifer, which thickens from 200 feet along the eastern boarder of the county to 900 feet in the western part of the area, consists of lenticular beds of sand, silt, and clay. It contains a large quantity of fresh to slightly saline water—the upper 400 feet contains an estimated 17 million acre-feet of water which can be developed economically. Recharge is mainly through heavy precipitation.—*from* Author's abstract

7803 **Broughton, Paul.** Calcite scalenohedrons: Earth Sci., v. 19, no. 6, p. 256-257, illus., 1966.

Scalenohedral calcite from vugs and cracks in dolomitic limestone in a quarry at Thomasville, Pa., is described, and collecting techniques given. Pyrite, quartz, and fluorite also have been reported indicating a hydrothermal origin.—E.S.L.

7766 **Brown, C. Ervin; Thayer, T. P.** Vester Formation, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244-A, p. A27-A29, illus., 1966.

7768 **Brown, C. Ervin; Thayer, T. P.** Aldrich Mountains Group, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244-A, p. A25-A27, 1966.

Brown, C. Ervin. *See* Thayer, T. P. 7769

8217 **Brown, C. Q.** Sillimanite in Pickens County, South Carolina: South Carolina Div. Geology Geol. Notes, v. 10, no. 1, p. 4-7, illus., 1966.

Unusual residual boulder-sized crystalline masses of virtually pure sillimanite occur associated with a large area of biotite gneiss in the southeastern corner of Pickens County, South Carolina. [A geologic sketch map of the Lusk-Moody area is included]. The sillimanite occurs with muscovite, sericite or biotite mica, and commonly with garnet. Sillimanite crystals commonly measure 1 by 4 inches and resemble kyanite in habit. Some of the pure sillimanite is associated with tourmaline and in one sample with sapphire.—Author's abstract.

Brown, G. *See* Rayner, J. H. 8130

Brown, R. E. *See* Geiger, K. W. 8220

Brown, Thomas E. *See* Kennedy, Vance C. 8140

7992 **Brückner, W. D.** Stratigraphy and structure of west-central Newfoundland [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 137-151, illus., 1966.

Three main structural divisions can be distinguished: the autochthonous terrane of Precambrian-Ordovician carbonate strata, the klippe terrane with four tectonic slices containing Cambrian-Ordovician rocks, and the neo-autochthonous sequences, of two ages, unconformably overlying the other two. Stratigraphy of the autochthonous terrane comprises six formations in the lower part, the St. George

Group in the middle part, and the Table Head Group in the upper part. The klippe terrane is the same as the Humber Arm Series or Group which includes five sedimentary formations, and volcanic and intrusive rocks. Chaotic zones occur along all tectonic boundaries. Two formations have been distinguished in the Ordovician–Devonian neo-autochthonous sequence; the younger sequence is of Carboniferous age, and occurs only in patches. Geologic sketch maps of the Bay of Islands and Corner Brook–Humber Gorge areas are included.—E.S.L.

7828 **Bruun, Per.** Model geology—Prototype and laboratory streams: Geol. Soc. America Bull., v. 77, no. 9, p. 959–973, illus., tables, 1966.

The results of stream geometry research are discussed with reference to existing regime formulas and their applications to a model river and to field studies. Remarkable similarities exist between flow, stream, and bed-geometry characteristics regardless of stream size. Some differences may be explained by hydraulic considerations based on the development of bottom geometry.—A.G.

Brydon, J. E. *See* Kodama, H. 8120

8066 **Buddington, A. F.** The occurrence of garnet in the granulite-facies terrane of the Adirondack highlands—A discussion [of paper by D. De Waard, 1965]: Jour. Petrology, v. 7, no. 2, p. 331–335, 1966.

De Waard based his paper (ibid., v. 6, p. 165–191, 1965) largely on ACF diagrams, emphasizing the role of composition in development of garnet in Adirondack rocks as contrasted with the role of temperature. The significance of the composition factor must be evaluated in the light of the proven increase in temperature across five zones of metamorphism distinguished in the garnet, from northwest to southeast. ACF plots can only afford rough indications, and were devised primarily for systems with excess silica. Three garnetiferous metagabbroic rocks, none with excess silica, belong to the hornblende-granulite subfacies, and four to the pyroxene-granulite subfacies. Composition is not necessarily the decisive factor in development of the garnets.—G.D.C.

7921 **Burkart, Burke.** (compiler). Mapa geológico de Guatemala—Chanmagua (Hoja 2359 IG): Guatemala City, Guatemala, Inst. Geográfico Nacional, scale 1:50,000, 1966.

7825 **Burnett, Harold Morris.** Applications of time-resolved spectroscopy to spectrochemical analysis [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 379B, 1966.

Burnham, Charles W. *See* Prewitt, C. T. 7968

8143 **Burnham, Charles W.; Radoslovich, E. W.** Refinement of the crystal structures of coexisting muscovite and paragonite [abs.], *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 27–28, 1966.

7949 **Byström-Asklund, Ann Marie.** Sample cups and a technique for sideward packing of *x* ray diffractometer specimens: Am. Mineralogist, v. 51, no. 7, p. 1233–1237, illus., 1966.

Powder samples, largely free of dimensional orientation, can be mounted for X-ray diffractometer study by an improved technique of lateral packing. The technique, described in detail, can be used for both stationary and rotational sample assemblies.—E.Z.

7780 **Caley, John F.** Memorial to George Sherwood Hume (1893–1965): Geol. Soc. America Bull., v. 77, no. 9, p. P179–P184, portrait, 1966.

Callahan, William R. *See* Hovis, W. A., Jr. 8219

7848 **Calvert, Ronald H.** Geologic map of the Maceo quadrangle, Daviess and Hancock Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-570, scale 1:24,000, section, text, 1966.

Coal is the principal mineral resource of the Maceo quadrangle. The Lewisport coal bed, the main producer, is mined for both domestic and industrial use and has been extensively strip mined along the east border. The 20- to 30-ft-thick clay shale above the Lewisport is a possible raw material for lightweight aggregate. Oil is produced from the Tar Springs Sandstone of Chester (Late Mississippian) age near Maceo at depths of 700-750 feet, and a few shows have been found in other Chester sandstones elsewhere. Chert gravel in the terrace deposits on hills east of Yelvington was quarried formerly for road metal.—M.C.M.

8104 **Calvert, S. E.** Origin of diatom-rich, varved sediments from the Gulf of California: Jour. Geology, v. 74, no. 5, pt. 1, p. 546-564, illus., tables, 1966.

Bottom sediments of the Gulf of California consist of regularly alternating light- (diatom-rich) and dark-colored (clay-rich) laminae. Light laminae are distinguished from dark by proportion of diatom frustules but not by differences in species. Radiocarbon dates indicate that one dark and one light lamina are deposited each year; thus the couplets are varves. Phytoplankton production is fairly constant through a year, but river discharge fluctuates greatly. The varves originate from relatively constant accumulation of biogenous material and superposed pulses of terrigenous material resulting from summer floods.—D.R.M.

8090 **Campbell, Ian A.** Stream profiles and pediments near Boulder, Colorado: Mtn. Geologist, v. 3, no. 4, p. 171-179, illus., table, 1966.

Graphical analysis of seven stream profiles in the Front Range between Boulder and Golden were undertaken to determine the possibility of correlating stream nick points with pediments. Four of the streams are of short length and have intermittent flow; the other three maintain regular discharge. Each stream profile was plotted, and breaks in the slope were identified and field checked. After determining the apparent significance of the nick points the section of stream channel above each nick point was extrapolated by an IBM 1620 computer. The extrapolated profiles were checked for degree of accordance with the height of the pediment with which the profile was deemed to have correlated. The degree of accordance is remarkably high when the nick points of obvious structural control are eliminated.—*from* Author's abstract

7850 **Canada Geological Survey.** Aeromagnetic four mile series, index to map sheets—Information to August 1, 1966: Ottawa, Ontario, Geol. Survey of Canada, 2 sheets [1966].

The 1-inch-to-four-mile series of aeromagnetic maps published by the Geological Survey of Canada as Geophysics Papers are numbered in the 7,000's. All provinces except British Columbia, Newfoundland, and District of Franklin (Northwest Territories) are represented on the two sheets (one for eastern and the other for western Canada).—M.C.M.

8184 **Canada Geological Survey.** Aeromagnetic series, index to map sheets—Information to August 1, 1966, Sheets 1-11, 14-16: Ottawa, Ontario, Geol. Survey Canada, 14 sheets, 1966.

The 1:63,360-scale aeromagnetic series are published as Geophysics Papers by the Geological Survey of Canada. Sheet 1 includes also the index to the ship magnetometer survey series. Sheets 12 and 13 covering extreme northern Quebec, southern Baffin Island; and most of the District of Keewatin, respectively, have not been published.—M.C.M.

8227 **Canada Geological Survey.** Aeromagnetic map, Eagle Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4028, scale 1:63,360, 1966.

8272 **Canada Geological Survey.** Aeromagnetic map, Kloo Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3291, scale 1:63,360, 1966.

8273 **Canada Geological Survey.** Aeromagnetic map, McKinley Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3292, scale 1:63,360, 1966.

8274 **Canada Geological Survey.** Aeromagnetic map, Sekulmun Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3293, scale 1:63,360, 1966.

8275 **Canada Geological Survey.** Aeromagnetic map, Albert Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3294, scale 1:63,360, 1966.

8276 **Canada Geological Survey.** Aeromagnetic map, Schist Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3295, scale 1:63,360, 1966.

8277 **Canada Geological Survey.** Aeromagnetic map, Grand Valley Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3300, scale 1:63,360, 1966.

8278 **Canada Geological Survey.** Aeromagnetic map, Pirate Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3301, scale 1:63,360, 1966.

8279 **Canada Geological Survey.** Aeromagnetic map, Gravel Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3302, scale 1:63,360, 1966.

8280 **Canada Geological Survey.** Aeromagnetic map, Gravel Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3303, scale 1:63,360, 1966.

8281 **Canada Geological Survey.** Aeromagnetic map, Aussie Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3304, scale 1:63,360, 1966.

8282 **Canada Geological Survey.** Aeromagnetic map, Fish Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3305, scale 1:63,360, 1966.

8283 **Canada Geological Survey.** Aeromagnetic map, Kathleen Lakes, Yukon Territory: Canada Geol. Survey Geophysics Paper 3306, scale 1:63,360, 1966.

8284 **Canada Geological Survey.** Aeromagnetic map, Canyon, Yukon Territory: Canada Geol. Survey Geophysics Paper 3307, scale 1:63,360, 1966.

8285 **Canada Geological Survey.** Aeromagnetic map, Ittlemit Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3308, scale 1:63,360, 1966.

8286 **Canada Geological Survey.** Aeromagnetic map, Aishihik Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3309, scale 1:63,360, 1966.

8287 **Canada Geological Survey.** Aeromagnetic map, Aishihik, Yukon Territory: Canada Geol. Survey Geophysics Paper 3310, scale 1:63,360, 1966.

8288 **Canada Geological Survey.** Aeromagnetic map, Lonely Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3311, scale 1:63,360, 1966.

8289 **Canada Geological Survey.** Aeromagnetic map, Cold Spring Mountain, Yukon Territory: Canada Geol. Survey Geophysics Paper 3316, scale 1:63,360, 1966.

8290 **Canada Geological Survey.** Aeromagnetic map, Reid Lakes, Yukon Territory: Canada Geol. Survey Geophysics Paper 3317, scale 1:63,360, 1966.

8291 **Canada Geological Survey.** Aeromagnetic map, McQuesten, Yukon Territory: Canada Geol. Survey Geophysics Paper 3318, scale 1:63,360, 1966.

8292 **Canada Geological Survey.** Aeromagnetic map, Clear Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3319, scale 1:63,360, 1966.

8293 **Canada Geological Survey.** Aeromagnetic map, Clum Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3320, scale 1:63,360, 1966.

8294 **Canada Geological Survey.** Aeromagnetic map, One Eighty Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3321, scale 1:63,360, 1966.

8295 **Canada Geological Survey.** Aeromagnetic map, Takhanne River, Yukon Territory: Canada Geol. Survey Geophysics Paper 3322, scale 1:63,360, 1966.

8296 **Canada Geological Survey.** Aeromagnetic map, Kluhini River, Yukon Territory: Canada Geol. Survey Geophysics Paper 3323, scale 1:63,360, 1966.

8297 **Canada Geological Survey.** Aeromagnetic map, Mount Bratnober, Yukon Territory: Canada Geol. Survey Geophysics Paper 3324, scale 1:63,360, 1966.

8298 **Canada Geological Survey.** Aeromagnetic map, Cracker Creek, Yukon Territory: Canada Geol. Survey Geophysics Paper 3325, scale 1:63,360, 1966.

8299 **Canada Geological Survey.** Aeromagnetic map, Hutshi Lakes, Yukon Territory: Canada Geol. Survey Geophysics Paper 3326, scale 1:63,360, 1966.

8300 **Canada Geological Survey.** Aeromagnetic map, Hopkins Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3327, scale 1:63,360, 1966.

8301 **Canada Geological Survey.** Aeromagnetic map, MacIntosh Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 3328, scale 1:63,360, 1966.

8302 **Canada Geological Survey.** Aeromagnetic map, Upper Nisling River, Yukon Territory: Canada Geol. Survey Geophysics Paper 3329, scale 1:63,360, 1966.

8303 **Canada Geological Survey.** Aeromagnetic map, Sydney Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4010, scale 1:63,360, 1966.

8304 **Canada Geological Survey.** Aeromagnetic map, Medicine Stone Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4011, scale 1:63,360, 1966.

8305 **Canada Geological Survey.** Aeromagnetic map, Pipestone Bay, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4012, scale 1:63,360, 1966.

8306 **Canada Geological Survey.** Aeromagnetic map, Bigshell Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4013, scale 1:63,360, 1966.

8307 **Canada Geological Survey.** Aeromagnetic map, Roderick Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4014, scale 1:63,360, 1966.

8308 **Canada Geological Survey.** Aeromagnetic map, Sheet 52 M/16, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4015, scale 1:63,360, 1966.

8309 **Canada Geological Survey.** Aeromagnetic map, Old Shoes Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4016, scale 1:63,360, 1966.

8310 **Canada Geological Survey.** Aeromagnetic map, Apps Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4017, scale 1:63,360, 1966.

8311 **Canada Geological Survey.** Aeromagnetic map, Deer Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4018, scale 1:63,360, 1966.

8312 **Canada Geological Survey.** Aeromagnetic map, Sheet 53 D/16, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 4019, scale 1:63,360, 1966.

8313 **Canada Geological Survey.** Aeromagnetic map, Varveclay Lake, Manitoba-Ontario: Canada Geol. Survey Geophysics Paper 4020, scale 1:63,360, 1966.

8314 **Canada Geological Survey.** Aeromagnetic map, York Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4023, scale 1:63,360, 1966.

8315 **Canada Geological Survey.** Aeromagnetic map, Murray Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4025, scale 1:63,360, 1966.

8316 **Canada Geological Survey.** Aeromagnetic map, Gods Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4026, scale 1:63,360, 1966.

8317 **Canada Geological Survey.** Aeromagnetic map, McIvor Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4027, scale 1:63,360, 1966.

8318 **Canada Geological Survey.** Aeromagnetic map, Eulas Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4788, scale 1:63,360, 1966.

8319 **Canada Geological Survey.** Aeromagnetic map, McTavish Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4789, scale 1:63,360, 1966.

8320 **Canada Geological Survey.** Aeromagnetic map, Forbes Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4790, scale 1:63,360, 1966.

8321 **Canada Geological Survey.** Aeromagnetic map, Birch Rapids, Saskatchewan: Canada Geol. Survey Geophysics Paper 4799, scale 1:63,360, 1966.

8322 **Canada Geological Survey.** Aeromagnetic map, Otter Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4800, scale 1:63,360, 1966.

8323 **Canada Geological Survey.** Aeromagnetic map, Guncoat Bay, Saskatchewan: Canada Geol. Survey Geophysics Paper 4801, scale 1:63,360, 1966.

8324 **Canada Geological Survey.** Aeromagnetic map, Nemeiben Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4809, scale 1:63,360, 1966.

8325 **Canada Geological Survey.** Aeromagnetic map, Stanley, Saskatchewan: Canada Geol. Survey Geophysics Paper 4810, scale 1:63,360, 1966.

8326 **Canada Geological Survey.** Aeromagnetic map, Nistowiak Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4811, scale 1:63,360, 1966.

8327 **Canada Geological Survey.** Aeromagnetic map, Cartier Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4821, scale 1:63,360, 1966.

8328 **Canada Geological Survey.** Aeromagnetic map, Rochon Lake, Manitoba: Canada Geol. Survey Geophysics Paper 4024, scale 1:63,360, 1966.

8005 **Canney, F. C.; Wing, Laurence A.** Cobalt—Useful but neglected in geochemical prospecting [reply to discussion by G. Harden, 1966, of paper by Canney and Wing]: Econ. Geology, v. 61, no. 7, p. 1294, 1966.

Field determinations of Cu, Ni, and Co used in original article (ibid., v. 61, p. 198–203) were obtained by emission spectrography in a truck-mounted laboratory.—W.S.W.

8201 **Carlson, H. D.** Ogden township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P.341, scale 1 in. to 1/4 mi., 1966.

8202 **Carlson, H. D.** Deloro township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P.342, scale 1 in. to 1/4 mi., 1966.

8203 **Carlson, H. D.** Shaw township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P.343, scale 1 in. to 1/4 mi., 1966.

8244 **Carr, D. D.; Felli, J.; French, R. R.; Hatfield, C.; Howard, J.; Votaw, R.; Potter, P. E.** Cross-bedding in the Salem Limestone of central Indiana: Sedimentology, v. 6, no. 2, p. 95–114, illus., tables, 1966.

In the middle Mississippian Salem Limestone of central Indiana, 693 measurements showed that sediment transport during Salem deposition was to the southwest, as

during deposition of most of the late Paleozoic sands of the Illinois Basin. Cross-bedding direction is variable, however, and noticeably bimodal. Oscillating tidal currents on a shallow marine shelf are believed to have caused pronounced bimodality in the Salem Limestone and the associated Ste. Genevieve and Harrodsburg Limestones.—Authors' summary

8054 **Carrington, Thomas J.** New fossil locality in the Butting Ram Sandstone of the Talladega Group, Chilton County, Alabama [abs.]: Alabama Acad. Sci. Jour., v. 37, no. 3, p. 258, 1966.

Chandool, D. E. *See* Dakshinamwite, C. 7885

Chao, E. C.-T. *See* Miesch, A. T. 8007

Charlesworth, H. A. K. *See* Cruden, D. M. 8062

7962 **Chaverri, J. G.; Black, C. A.** Solubility of phosphate rock: Soil Sci., v. 102, no. 2, p. 73–81, illus., 1966.

Experiments support the view that the treatment with acid of Florida phosphate rock caused alteration of the surface of hydroxylfluorapatite in the direction of fluorapatite. The process involves a reaction of dissolved hydroxyl ions with hydrogen ions of the acid and a subsequent interaction of dissolved fluoride ions with the residual solid to enrich the surface layer with fluoride at the expense of hydroxyl.—J.W.H.

8008 **Chayes, Felix; Kruskal, William.** An approximate statistical test for correlations between proportions: Jour. Geology, v. 74, no. 5, pt. 2, p. 692–702, tables, 1966.

The observed means and variances of data occurring as proportions or percentages may be used to estimate analogous parameters of a theoretical open array, X, which, on closure, yields a new array, Y, whose means and variances are exactly those of the observed data, but in which the covariances have been generated entirely by closure. The correlations in Y, found directly from the means and variances of X, are appropriate null values against which the observed correlations may be tested. A testing procedure is outlined, and a practical example is given.—Authors' abstract

8021 **Cheney, Eric S.; Lange, Ian M.** Evidence for sulfurization and the origin of Sudbury-type ores [abs.]: Econ. Geology, v. 61, no. 7, p. 1299–1300, 1966.

8158 **Chenoweth, P. A.** Type section of the Oologah Limestone: Oklahoma Geology Notes, v. 26, no. 7, p. 193–208, illus., 1966.

A core of the complete interval of the Oologah Formation (Pennsylvanian) in the type locality near Oologah, Okla., is described. Three members are recognized: the Altamont Member, with a typical lithology of alternating beds of limestone and algal shale; the Bandera Member, composed of dark shales and calcareous siltstones containing pyrite, glauconite, and phosphatic nodules; and the Pawnee Member, a typically crinoidal limestone. History of the stratigraphic nomenclature is reviewed briefly.—B.S.H.

Cherry, R. N. *See* Pride, R. W. 7804

Chidester, A. H. *See* Hatch, N. L., Jr. 7765

Chilton, F. *See* Eisler, J. D. 8193

7775 **Christiansen, Robert L.; Barnes, Harley.** Three members of the Upper Cambrian Nopah Formation in the southern Great Basin, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244-A, p. A49–A52, illus., 1966.

Christopher, Peter A. *See* Barnard, Walther M. 7997

7785 **Ciriacks, Kenneth Wilmer.** Permian and Eotriassic bivalves of the Middle Rockies [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 518B, 1966.

8004 **Clark, A. Horrell.** Reflectivity measurements on molybdenite [discussion of paper by J. H. Leow, 1966]: Econ. Geology, v. 61, no. 7, p. 1293–1294, 1966.

In commenting on the paper by Leow (ibid., v. 61, p. 598–612) Clark points out that X-ray powder diffraction data or analytical data would increase value of reflectivity data on molybdenite, since reflectivity may be affected by polytypism and tungsten solid solution.—W.S.W.

Clark, G. W. *See* Kopp, O. C. 7956

8222 **Clark, Joan R.; Papike, J. J.** Eclogitic pyroxenes, ordered with P2 symmetry: Science, v. 154, no. 3752, p.1003–1004, illus., table, 1966.

X-ray diffraction crystal-structure analysis of omphacite from eclogite, Tiburon Peninsula, Marin County, California, shows that this clinopyroxene has P2 symmetry with a nearly ordered distribution of the multiple cation content defined by its approximate formula.—*from* Authors' abstract

7811 **Clark, Robert T.; Bales, James D.** Why scientists accept evolution: Grand Rapids, Mich., Baker Book House, 113 p., 1966.

The premise is that evolution was accepted because of the determination to rule out the possibility of creation by God. The first six chapters are devoted to lives and writings of six early evolutionists. The antisupernatural bias of other scientists is covered in chapter 7. An attempt to prove that evolution is a faith and not a fact, by quotations from evolutionists, comprises the 8th chapter. In chapter 9, the conclusion is reached that the question of the truth or falsity of evolution should be reopened, and that the hypothesis be required to pass as rigid tests as others, before being considered theories.—E.S.L.

7930 **Cleveland, John H.** Flow diagram for a computer program designed to calculate igneous molecular norms: Indiana Acad. Sci. Proc. 1965, v. 75, p. 175–177, illus., 1966.

The paper presents the unpublished flow diagram for igneous normative mineral computation in a form adaptable to any electronic digital computer, or as a guide for manual norm computation instruction. The diagram represents a mathematical sequence of operations making possible conversion of the chemical analysis of the rock into the probable quantitative mineral assemblage.—E.S.L.

8125 **Cloos, P.; Mortland, M. M.** Expansion and electrical conductivity of montmorillonite in ammonia atmosphere, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 231–246, illus., 1966.

A 12.3 Å spacing was obtained with alkali-metal and alkaline-earth cations at low relative pressures, which represents one layer of ammonia in the interlamellar spaces. This spacing was maintained up to saturation for the K and Mg systems. For Li-, Na-, and Ca-clay, two layers of ammonia were formed at higher pressures, and for Cu- and Co-clays, rational spacings at 12.8 and 15.1 Å respectively were obtained at low relative pressures and were maintained to saturation. The results are interpreted in terms of coordination complex formation. Electrical conductance studies showed exponential increases in conductivity as the pressure of ammonia increased. Activation energies showed decreases with increase in pressure for most systems. Results indicated that expansion and electrical conductivity were influenced by formation of the ammonium ion and coordinating power of the exchangeable cation.—*from* Authors' abstract

Cloud, Preston E., Jr. *See* Barnes, Virgil E. 8252

7792 **Coffin O., José; Sarabia, Juan M.** Método gráfico para el cálculo de tendidos, en la aplicación de sismos múltiples y/o pozos múltiples en áreas difíciles: Asoc. Mexicana Geofísicos Explor. Bol., v. 7, no. 2, p. 99–124, illus., 1966.

Seismic noise is discussed of the type that has a frequency range similar to that of the signal and can neither be eliminated nor attenuated before detection, nor corrected by instrumental operations. Normally the use of a seismometer spread larger than 12 detectors per group is not practical; however, when a large coverage is employed with reduced spacing between seismometers and there is a large noise spectrum or a very high level of incoherent noise, larger groupings may be effective. Expressions are given for graphic analysis of the combined response from multiple seismometers and shotpoints in a line in order to calculate the improvement in value of signal/noise ratio. Graphs are illustrated for spreads of 20 seismometers and 5 or 7 shotpoints. An example is cited from an area southeast of Ciudad de Nuevo Laredo, Tamaulipas, Mex.—V.S.N.

7777 **Cohee, George V.; West, Walter S.** Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244–A, p. A1–A60, illus., tables, 1966.

The changes in stratigraphic nomenclature are grouped together in the categories of (1) new names adopted for official use, (2) previously used names adopted for official use, (3) names revised, (4) changes in age designation, (5) names reinstated, and (6) names abandoned. The stratigraphic names involved in change are listed alphabetically under each category. The age of the unit, the area in which the name is employed, the title of the report, and the publication in which the change is described, are given.—*from* Authors' introduction

Cohen, L. *See* Ribbe, P. H. 8226

7830 **Cohenour, R. E.; Thompson, K. C.** Geologic setting of Great Salt Lake, *in* The Great Salt Lake: Utah Geol. Soc. Guidebook to Geology of Utah, no. 20, p. 35–56, illus., 1966.

Great Salt Lake basin on the downthrown side of the Wasatch Fault is one of the lowest depressions in the Great Basin Province. The north trending, linear mountain ranges which define the depression are described briefly, as well as the eight islands within the depression which appear to be remnants of fault block mountains. The fluctuating lake divests itself of its islands when it shrinks to an elevation of 4,191 feet, and encompasses them all when it rises 19 feet. Nearly all types of sedimentary and igneous rock are represented within the watershed, more than 70,000 feet displayed in the mountains ranging in age from oldest Precambrian to Recent. In addition to the brief discussions of geomorphology and geologic history, a generalized geologic and tectonic map is presented.—G.D.C.

7880 **Cohenour, R. E.** Industrial development and potential of Great Salt Lake with notes on engineering and operational problems, *in* The Great Salt Lake: Utah Geol. Soc. Guidebook to Geology of Utah, no. 20, p. 153–163, illus., 1966.

The chief commodity produced from Great Salt Lake is ordinary salt; four solar evaporation facilities harvest 300 to 400 thousand tons annually. The extraction of magnesium and lithium is being developed. A viscous oil, which contains 13 percent sulfur, is produced from five wells in the Rozel Point field, and an oil and gas show in buried Paleozoic strata has been recorded at the south end of the lake. Roughly 2 million tons of dissolved solids are contributed annually to the lake, which contains in excess of 5 billion tons of dissolved minerals. Until 1959 there was practically no precipitation of sodium chloride to the lake bottom; winter deposits of mirabilite are redissolved as the lake warms. Recrystallized mirabilite cements oolitic sand lenses, which protected by clay are resistant enough to support causeways, as are also the algal reefs.—G.D.C.

8170 **Collins, George M., Jr.** 13 billion-bbl. potential for Beaufort Sea area: Oilweek, v. 17, no. 27, p. 43–44, 46, illus., 1966.

The Mackenzie Delta–Beaufort Sea area is one of the most attractive areas in northern Canada for petroleum exploration. The area may contain as much as 12.8 billion bbls of recoverable oil. The Arctic Coastal Plain–Beaufort Shelf province lies north of the Interior Plains and Cordilleran regions, and covers about 45,000 sq mi. Structures in the Cordillera plunge beneath the Coastal Plain, and the Colville geosynclinal basin can be projected into the Beaufort Shelf area. A sedimentary section 20,000 feet thick, 75 percent Mesozoic and younger, underlies the area. The regional setting is compared to the Gulf Coastal Plain and shelf. The presence of hydrocarbons is indicated by oil and gas seeps, bituminous shales, and oil sands. The Cretaceous productive area on the west probably extends into the area.—E.S.L.

7909 **Colton, George W.; Luft, Stanley J.** Bedrock geology of the Slate Run quadrangle, Clinton, Lycoming, and Potter Counties, Pennsylvania [map]: Pennsylvania Geol. Survey Prog. Rept. 167, 1 sheet, scale 1:24,000, text, 1965 [1966].

This preliminary report uses informal stratigraphic names because the writers believe additional work will result in a better understanding of stratigraphic relations; a chart shows comparison of nomenclature in this quadrangle and nearby areas. Flagstone is the only product obtained in quantity from the bedrock in the quadrangle; rock suitable for commercial grade occurs in the upper part of thick gray sandstone units overlain by predominantly red sandstone, siltstone, shale, or mudstone beds. Two commercially unsuccessful deep wells have been drilled for oil and gas; scant data and local reports suggest that the potential gas-bearing "Oriskany sand" was not penetrated because of two faults.—M.C.M.

8067 **Condie, Kent C.** Late Precambrian rocks of the northeastern Great Basin and vicinity: Jour. Geology, v. 74, no. 5, pt. 1, p. 631–636, illus., 1966.

These rocks, mainly quartzite (q), unconformably overlie older plutonic–metamorphic complexes and west of the Wasatch Range seem to grade upward into Cambrian rocks instead of underlying them unconformably. Late Precambrian rocks define three subprovinces whose sedimentary assemblages, histories, and perhaps source areas are different. From west to east, subprovinces are: I (Ruby Mountains–Albion Range)—q, biotite schist, marble, amphibolite, with source unspecified; II (Egan Promontory–Bannock Ranges)—q, subgraywacke, conglomeratic subgraywacke (including "tillite"), dolomite, metadiabase, with source northeast to east; III (Uinta Range, possibly overlapping II in Wasatch Range)—q, arkose, subgraywacke, with source mainly north. Relations between subprovinces are obscured by inadequate exposures, faults, and differences in metamorphic grade. Some regional metamorphism is post Paleozoic.—B.F.L.

8079 **Connor, Carol Waite; Ferm, John C.** Precision of linear and areal measurements in estimating grain size: Jour. Sed. Petrology, v. 36, no. 2, p. 397–402, illus., 1966.

In the study of sedimentary particles, volume is the best definition of size. Measurements made on cross sections of grains in thin section are estimates of volume. Measurements were made of the A (long) and B (perpendicular to A) axes and the areas of maximum projection planes, random planes and thin-section planes of 60 pebbles to test the effectiveness of each in estimating the known volume of the pebbles. Regression analysis was used to compare methods. The area of the maximum projection plane is the most precise estimator of size. The thin-section plane area is slightly more precise than the A axis but not enough to justify the extra time required. There is no significant difference between use of the A or B axis.—R.A.C.

7831 **Cook, Kenneth L.; Berg, Joseph W., Jr.; Johnson, William W.; Novotny, Robert T.** Some Cenozoic structural basins in the Great Salt Lake area, Utah, indicated by regional gravity surveys, *in* The Great Salt Lake: Utah Geol. Soc. Guidebook to Geology of Utah, no. 20, p. 57–75, illus., 1966

Regional gravity surveys over the mud and salt flats, on some of the islands, and over adjacent areas of the lake, indicate features of Laramide and older structures, especially those related to Basin and Range faulting. A pronounced gravity high indicates a great fault block with an unexposed spur extending southeast of Antelope Island; along its eastern margin is a continuous major fault zone extending

northward. Gravity lows reflect the Cenozoic structural basins of the Rozel, Strongknob, Lakeside–Stansbury, Tooele Valley, East Antelope Island, and Bear River Bay grabens. These are of sufficient size that saline deposits of economic value may exist within some of them below the present ground or lake-bottom surface.—G.D.C.

8069 **Cooke, G. A.** The Waterton gas field [abs.]: Oilweek, v. 17, no. 30, p. 34, 1966.

7908 **Cooley, M. E.** (and others). Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Pt. 4, Maps showing locations of wells, springs, and stratigraphic sections: Arizona Land Dept. Water Resources Rept. 12–D, 2 sheets, scale about 1 in. to 6 mi., text, 1966.

The sheets contain an index map; a map showing locations of drilled wells, test holes, and selected stratigraphic sections; a map of locations of dug wells, infiltration galleries, sumps, and springs; and a map of the well-numbering system.—M.C.M.

7882 **Cordon, T. C.** Synthetic detergents—Some aspects of their relation to agriculture: Soil Sci., v. 102, no. 1, p. 1–17, illus., 1966.

Detergents will continue to be added to soils through waste disposal practices. Since surface-active agents do not affect soils and the processes occurring therein, continued study to clarify these reactions seems justified. Furthermore, in view of the water shortage that is facing this country, the possibility of conserving soil moisture by the application of surface-active agents has tremendous implications. It appears that increased research in this area might yield rich dividends.—J.W.H.

8089 **Covington, George.** Stratigraphy and sedimentary structures in the Fox Hills Sandstone (Upper Cretaceous), Golden area, Colorado: Mtn. Geologist, v. 3, no. 4, p. 161–169, illus., table, 1966.

A study of the Fox Hills Sandstone (Upper Cretaceous) in the Golden, Colorado area has determined that the formation was deposited in a beach and shallow-marine environment. The environmental analysis is based on a study of the sedimentary structures and comparisons to Recent sediments. South of Golden, a tongue of marine shale, similar to the underlying Pierre Shale, occurs in the upper part of the Fox Hills interval. Trends of ancient shorelines, based on the analysis of ripple marks, show an orientation varying from north–south to slightly west of north, but shifting to northeast during the time of deposition of the marine shale tongue. Measured stratigraphic sections are given.—*from* Author's abstract

Cowley, W. R. *See* Gerard, C. J. 7887

7875 **Cox, Allan; Hopkins, David M.; Dalrymple, G. Brent.** Geomagnetic polarity epochs—Pribilof Islands, Alaska: Geol. Soc. America Bull., v. 77, no. 9, p. 883–909, illus., tables, 1966.

A comparison is made between geologic, radiometric, and paleomagnetic methods of dating and stratigraphic correlation on the Pribilof Islands, Alaska, and a synthesis is made of their geologic and geomagnetic history. Seventeen K–Ar age determinations on basalts and paleomagnetic measurements on basalt samples from 65 sites provide data concerning polarity epochs and events up to 2.2 m.y. ago.—A.G.

Craig, J. R. *See* Naldrett, Anthony J. 8031

7922 **Crane, David C.** (compiler). Mapa geológico de Guatemala—Timushán (Hoja 2360 IIG): Guatemala City, Guatemala, Inst. Geográfico Nacional, scale 1:50,000, 1966.

8230 **Creath, W. G.; Shaw, A. B.** Paleontology of northwestern Vermont—[Pt.] 13, *Isochilina* from the Ordovician Highgate Formation: Jour. Paleontology, v. 40, no. 6, p. 1331–1334, illus., 1966.

All known specimens of ostracodes from the Ordovician Highgate Formation of Vermont have been restudied and are illustrated photographically. In addition, three related species described by R. P. Whitfield in 1889 are redescribed and figured for comparison. Six species and one synonymous name are recognized: *Isochilina eximia* (= *I. bilabiata*), *I. puteata*, and *I. tenuifila*, all named by P. E. Raymond in 1937, from the Highgate; and *I. cristata*, *I. gregaria*, and *I. seelyi*, all of Whitfield.—Authors' abstract

8221 **Crocket, James H.; Winchester, John W.** Coprecipitation of zinc with calcium carbonate: Geochim. et Cosmochim. Acta, v. 30, no. 10, p. 1093–1109, illus., tables, 1966.

The distribution of zinc between precipitates of $CaCO_3$ and saturated aqueous solution at low ionic strength has been measured at 25°, 35°, and 50°C. Digestion of the 50°C precipitate for 2 weeks at that temperature with stirring produced homogeneous distribution, but with similar treatment at 25° and 35°C exactly logarithmic distributions were found. Recrystallization must be extensive at 50° and very slow at 25° and 35°; this is consistent with observations on calcite aragonite composition of precipitates. Many carbonates of trace elements are less soluble than calcite or aragonite, and should be coprecipitated with $CaCO_3$ in nature.—D.B.V.

8062 **Cruden, D. M.; Charlesworth, H. A. K.** The Mississippie–Jurassic unconformity near Nordegg, Alberta: Bull. Canadian Petroleum Geology, v. 14, no. 2, p. 266–272, 1966.

Bedding on both sides of the Mississippian–Jurassic unconformity is so nearly parallel that the angular relationship of the formations involved is difficult to determine by conventional means. Bedding-plane orientation data from four localities where the beds of the Jurassic Fernie Formation are subparallel to those of the Mississippian Mount Head Formation were investigated by the Fisher probability density function test. An analysis of 88 bedding-plane readings shows that the angular discordance ranges from 3.2 to 4.2 degrees.—W.A.C.

8015 **Curl, Rane L.** Caves as a measure of karst: Jour. Geology, v. 74, no. 5, pt. 2, p. 798–830, illus., tables, 1966.

The development of a statistical distribution of proper entrances among proper caves in a limestone karst is considered as a geomorphic process and described with stochastic geomorphic models. One of the models is used to obtain a constant which is characteristic of a karst and to predict the number and length distributions of entranceless caves and the length distribution of all caves in each region. The karst constant varies from about 0.0001 to 0.01 ft^{-1}. Comparisons between the karst constants in the different regions suggest a correlation with the underlying karst processes and disclose an apparently unique karst situation in County Clare, Ireland. Predictions of complete length distributions of all caves show similarities not found in observed length distributions and support the conclusion that the proper interpretation of a cave region demands information about unobservable caves.—Author's abstract

Cuttitta, Frank. *See* Miesch, A. T. 8007

7885 **Dakshinamwite, C.; Chandool, D. E.** Isoconductivity value and cation-exchange capacity of soils and clays: Soil Sci., v. 102, no. 2, p. 123–130, illus., 1966.

A linear relationship between cation-exchange capacity and isoconductivity values was found to be similar for both soils and their clay separates. The exchange-capacity values range between 10 and 105 milliequivalents per 100 grams. A fairly reliable method of estimating the exchange capacity from conductance measurements of soil or clay suspensions in calcium chloride electrolyte systems is described. J.W.H.

8254 **Dalquest, Walter W.** An unusual paleonisciform fish from the Permian of Texas: Jour. Paleontology, v. 40, no. 3, p. 759–762, illus., 1966.

Schaefferichthys leudersensis new genus and species is described from the Leuders Formation near Lake Kemp, Baylor County. It is probably a member of the Platysomidae.—F.C.W.

Dalrymple, G. Brent. *See* Cox, Allan. 7875

8197 **Davies, J. C.; Pryslak, A. P.** (compilers). Savant–Caribou Lakes sheet, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P.352, scale 1 in. to 2 mi., 1966.

8198 **Davies, J. C.; Pryslak, A. P.** (compilers). Minnitaki–Sturgeon Lakes sheet, Districts of Kenora and Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P.353, scale 1 in. to 2 mi., 1966.

8040 **Davies, J. L.** Geology of Bathurst–Newcastle area, N. B. [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 33–43, tables, 1966.

The Bathurst–Newcastle area is located near the axis of the zone of initial deformation in the Appalachian mobile belt. Rocks are divided into three regional units—the Ordovician folded belt on the south (Tetagouche Group), the Silurian–Devonian folded belt on the north, and the relatively undeformed Pennsylvanian unit to the east; formations are tabulated. The four lithologic divisions of the Tetagouche Group and the intrusive rocks are described. Massive and vein-type sulfide deposits occur in the Ordovician. The form and mineralogy, and textural and structural features of the massive deposits are discussed and reserve data and trace elements tabulated.—E.S.L.

8041 **Davies, J. L.; Smith, R. N.** Geology of the Brunswick No. 6 and No. 12 sulphide deposits [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 45–57, illus., table, 1966.

The deposits occur about six miles apart at either end of a broad S-shaped fold in regionally metamorphosed Ordovician rocks intruded by igneous rocks. The two deposits occur in tight isoclinal folds near the contact between augen schists and iron-formation; these schists may represent metamorphosed ash-flow deposits. The iron-formation consists of banded magnetite–hematite–quartz facies and chlorite schist, and represents a mixed chemical-clastic sediment largely of exhalative origin. Each sulfide deposit has a large mass of fine-grained pyrite containing small amounts of other sulfides, a smaller mass of Zn–Pb ore, and a pyrite–pyrrhotite–chalcopyrite zone. The high-grade Zn–Pb part shows a close association with iron-formation and evidence of replacement of iron-formation by sulfides. The pyrite–pyrrhotite–chalcopyrite zones occur near the outer margins and are separate from parts rich in sphalerite–galena.—E.S.L.

8199 **Davies, John C.; Pryslak, A. P.** (compilers). Miniss Lake sheet, Districts of Kenora and Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P.354, scale 1 in. to 2 mi., 1966.

7870 **Davis, Briant L.** X-ray fabric study of Yule marble: Geol. Soc. America Bull., v. 77, no. 9, p. 1005–1016, illus., table, 1966.

Petrofabric analysis, using flat sections of marble from Yule Creek, Colorado, was done by the small-circle net X-ray technique. To avoid false maxima, geometric means of relative X-ray diffraction intensities were used. The well-known, optically determined fabric of axial symmetry consists of a c-axis point maximum normal to the foliation. The greater resolution of the X-ray method reveals an orthorhombic symmetry in which the maximum is split and lies in symmetrically disposed minor crossed girdles. Symmetry is lower in some sections where the split maximum and girdles are tilted relative to the foliation. This variation indicates fabric inhomogeneity in the domain of a hand sample. Other fabrics are: broad, great-circle a-axis girdle parallel to foliation, and small-circle girdles of r- and e-axes about c-axis maximum.—R.A.L.

Davis, Dan A. *See* Fischer, William A. 8074

Day, Walter C. *See* Paul, Roger A. 8248

Deininger, Robert W. *See* Neathery, Thornton L. 8029

8055 **Deininger, Robert W.** The petrology of the Auburn dike [abs.]: Alabama Acad. Sci. Jour., v. 37, no. 3, p. 259, 1966.

8257 **Delgado, Jose I.** Evaluación de la producción y utilización de los combustibles sólidos: Geología y Metalurgía, v. 2, no. 15, p. 28–35, 1966.

Fossil fuels considered here are coal, oil shale, and tar sands, reserves of which are enormous, and petroleum and natural gas. The reserves of coal, petroleum and natural gas in Mexico are listed with carbon percentages, and compared with world reserves. In terms of world distribution, North America has about 34.0 percent of the coal, 18.6 percent of the petroleum, and 43.6 percent of the natural gas. Mexico's tonnage production of equivalent carbon in 1964 was 47.2—4 percent in coal, 59 percent in petroleum, 32 percent in natural gas. Various uses of carbon from above sources, and methods of extraction are discussed briefly.—G.D.C.

Delia, Anthony. *See* Ricketts, John A. 7928

deVries, P. H. *See* Geiger, K. W. 8220

8105 **Dietz, Robert S.; Holden, John C.** Miogeoclines (miogeosynclines) in space and time: Jour. Geology, v. 74, no. 5, pt. 1, p. 566–583, illus., 1966.

Many continental margins are capped by wedge-shaped deposits (miogeoclines) of Cretaceous to Recent marine strata that are deposited almost horizontally and thicken seaward to terminate at the continental slope. These deposits are similar to more ancient miogeosynclines, which probably were not truly synclinal; miogeoclines probably have been formed throughout geologic time by sedimentation at the continental margins. Their outer limits mark former continental boundaries before the accretion of new fold belts. The Appalachian and Millard miogeoclines are probable Paleozoic examples, and possible Precambrian examples may be the Belt Series in Montana, the Huronian metasedimentary sequence in Canada, and the Witwatersrand Series in South Africa.—E.T.R.

8151 **Dobrin, Milton B.; Ingalls, Arthur L.; Long, James A.** Filtrado de velocidad y frecuencia de datos sísmicos usando luz laser: Asoc. Mexicana Geofísicos Explor. Bol., v. 7, no. 3, p. 131–201, illus., 1966; originally published 1965.

This is a Spanish translation of the paper originally published in English in Geophysics, v. 30, no. 6, p. 1144–1178, 1965. See Abstracts of North American Geology, June 1966.—V.S.N.

7976 **Dodd, Robert T., Jr.; VanSchmus, W. Randall; Marvin, Ursula B.** Significance of iron-rich silicates in the Mezö-Madaras chondrite: Am. Mineralogist, v. 51, no. 7, p. 1177–1191, illus., table, 1966.

Several chondrules in the Mezö-Madaras chondrite contain the disequilibrium mineral assemblage: ferrous olivine-magnesian pyroxene-merrihueite . . .± metallic nickel-iron. The ferrous silicates in this assemblage were probably formed by introduction of FeO into an earlier igneous assemblage which consisted of enstatite or clinoenstatite, a magnesian analogue of merrihueite, and silica. Textural and chemical evidence indicate that this alteration of the chondrules took place before they were incorporated in the chondrite.—Authors' abstract

Doe, B. R. *See* Rosholt, J. N. 7871

8190 **Donaldson, J. A.** Marion Lake map-area, Quebec-Newfoundland (23 I/13) [with French abs.]: Canada Geol. Survey Mem. 338, 85 p., illus., tables, geol. map, 1966.

The western two-thirds of the area is underlain by rocks of the Labrador trough and the eastern one third by Precambrian gneisses and amphibolites. Folds and major faults of the Labrador trough trend northwest and are truncated and separated from the gneisses by a reverse fault. In the southwestern corner sediments of the Knob Lake Group are separated from a volcanic belt in the central part of the area by a northwest-trending fault. East of the fault, greenschists of the Murdock Group outcrop. The overlying Doublet Group is composed of sediments and metavolcanics. Conformable basic sills underlie much of the area. To study carbonate sedimentation during the Proterozoic, the Denault Formation of the Knob Lake Group was studied in detail and a detailed stratigraphic section is given.—B.S.H.

Dougherty, Elmer L. *See* Smith, Stanley T. 8232

Dresher, W. H. *See* Naumann, A. W. 7978

8164 **Dunn, D. L.** New Pennsylvanian platform conodonts from southwestern United States: Jour. Paleontology, v. 40, no. 6, p. 1294–1303, illus., 1966.

Previously undescribed Early Pennsylvanian (Morrowan and Atokan or Derryan) platform conodonts are described from eight localities in Oklahoma, Texas, and Nevada. The 11 new species are assigned to six genera, of which *Declinognathodus* and *Rhachistognathus* are new. The new condont taxa are: *Cavusgnathus spatha, C. transitoria, Gnathodus defectus, Declinognathodus nevadensis, Idiognathodus humerus, I. incurvus, Streptognathodus angustus, S. anteeccentricus, S. parvus, S. suberectus*, and *Rhachistognathus prima*.—Author's abstract

7924 **Duquette, Gilles; Mathieu, Arthur.** Geology of the northeast quarter of McKenzie township, Abitibi-East county [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 551, 21 p., table, geol. map, 1966.

The rocks of this area near the town of Chibougamau are early Precambrian and are divided into three formations: the Lac Waconichi, a thick sequence of chlorite-rich pyroclastic rocks, overlain in turn by the Lac Gilman mafic lavas, and pyroclastic rocks and mafic lavas of the Lac Blondeau. Invaded in many places by sill-like bodies, the whole series has been folded into a major syncline, striking slightly north of east. An assumed major fault across the northwest half is drift covered, but five minor faults were mapped, in one of which an important gold-bearing quartz vein dips 45° southeast; much steeper shearing suggests a thrust fault. Exploration since the early twentieth century, increasing in pace after 1950, has been for gold, copper, and asbestos. Mine properties are described briefly.—G.D.C.

7858 **Durham, J. Wyatt.** *Camptostroma*, an Early Cambrian supposed scyphozoan, referable to Echinodermata: Jour. Paleontology, v. 40, no. 5, p. 1216–1220, illus., 1966.

New material from the Kinzers Formation of Pennsylvania shows characters strongly suggestive of Echinodermata. The probable medusoid shape suggests a bathypelagic of planktonic habitat. The new class, Camptostromatoidea, is most closely related to Holothuroidea, although its proper place in the Echinodermata has not yet been determined.—R.E.G.

8191 **Eade, K. E.** Fort George River and Kaniapiskau River (west half) map-areas, New Quebec [with French abs.]: Canada Geol. Survey Mem. 339, 84 p., illus., tables, geol. map, 1966.

Most of the area is underlain by Archean granites, gneisses, and schists, but isolated occurrences of Proterozoic metasediments and volcanics are present also. In the western and central parts of the area the Archean rocks are of the amphibolite facies of metamorphism, while in the eastern part large areas of granulite facies rocks occur. Folds trend east in the western part of the area and gradually change to east-northeast in the eastern part. In the east, superimposed northwest-trending folding complicates the structural pattern. Faults are widespread. A major zone of disruption, extending from James Bay to the Labrador 'trough', accounts for the preservation of the hitherto unknown Sakami Formation of Proterozoic clastics

and volcanics in down-dropped blocks. Minor sulfide deposits occur throughout the area.—B.S.H.

Eades, J. L. *See* Gaudette, H. E. 8145

7878 **Eardley, A. J.** Sediments of Great Salt Lake, *in* The Great Salt Lake: Utah Geol. Soc. Guidebook to Geology of Utah, no. 20, p. 105–120, illus., 1966.

Sediments in Great Salt Lake are clays, oolites, and two types of algal reefs. The clays are exceptionally smooth and plastic and occur in the central part below 12 feet, in shallow embayments, and at river mouths; they are basically clay and silt with considerable precipitated calcium and magnesium carbonate. Dehydration and compaction down to 100 feet result in some polygonal fissures. Oolitic sand is largely confined to western shores; it is formed by carbonate precipitation under constant agitation around nuclei of minerals or brine-shrimp fecal pellets. A surficial bed of unknown extent on the southeast shore is cemented with mirabilite. Salt precipitation varies with temperature, lake level, and circulation. Cores reveal fresh water sediments below the lake bottom to a depth of 30 feet where brine sediments are again encountered. The Pleistocene record is interpreted from one 650-ft core near Saltair.—G.D.C.

Edie, R. W. *See* Andrichuk, J. N. 7809

Edmonds, R. J. *See* McGavock, E. H. 8210

8107 **Eggleton, R. A.; Bailey, S. W.** The crystal structure of stilpnomelane—Pt. 1, The subcell, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 49–63, illus., tables, 1966.

Ferric iron stilpnomelane is triclinic, and the structure is dominated by a subcell for which $a_s = 1/4a$, $b_s = 1/4b$, $c_s = 1/4c$, $\alpha_s = a$, $\beta_S = B$, $\Gamma_S = \Gamma$. The subcell reflections have $h-k = 3n$, and have trigonal intensity distribution. The structure was determined from Patterson projections and by trial and error. Stilpnomelane is a layer structure, having five anion and five cation planes parallel to (001). An iron-rich octahedral sheet is flanked by two tetrahedral sheets. Each tetrahedral sheet has 1.25 tetrahedra pointing toward the octahedral sheet, and 0.75 tetrahedra pointing away.–*from* Authors' abstract

7795 **Ehrenberg, Hans.** Reflected light microscopy, *in* Applied ore microscopy—Theory and technique (1st English edition): New York, Macmillan Co., p. 29–193, illus., tables, 1966.

The scope of reflected light microscopy and recent developments in microscope construction are reviewed. Characteristics of the microscopes discussed are types of opaque illuminators, designs of stage, the tube, illumination, and optical equipment; the most important instruments are described in detail and illustrated. Optical fundamentals are examined, and methods of determination—adjustment of the instruments, determination and qualitative observations of optical properties, and determination of external properties—are described. A short section is included on the preparation of samples.—E.S.L.

8028 **Eidel, J. James.** Crystallization and mineralization of a porphyry stock, Mohave County, Arizona [abs.]: Econ. Geology, v. 61, no. 7, p. 1305–1306, 1966.

8193 **Eisler, J. D.; Chilton, F.; Sauer, F. M.** Multiple subsurface spalling by underground nuclear explosions: Jour. Geophys. Research, v. 71, no. 16, p. 3923–3927, illus., 1966.

Multiple spalling of subsurface layers in the Earth accompanies the detonation of contained underground nuclear shots. Interpretation of available data for shots detonated in tuff, halite, and alluvium points to the existence of ascending and descending waves which produce spall and gaps in the subsurface. The records of particle acceleration at depth indicate an upward-traveling sequence of closures of these gaps. The pattern of spallation is similar for the tuff and halite shots.

For an alluvium shot, spallation appears to be largely the consequence of slumping of the cavity rather than of tensile stress waves reflected from the free surface.—Authors' abstract

8093 **Elder, J. L.; Kube, W. R.** (compilers). Technology and use of lignite—U.S. Bureau of Mines–University of North Dakota Symposium, Bismarck, N. Dak., 1965, Proc.: U.S. Bur. Mines Inf. Circ. 8304, 124 p., illus., tables, 1966.

Thirteen papers describe recent trends, developments, and research in lignite technology. Among the subjects included are an economic appraisal of lignite reserves, lignite utilization, and characteristics and variability of lignite ash.—E.R.L.

8088 **Ellis, C. Howard.** Paleontologic age of the Fountain Formation south of Denver, Colorado: Mtn. Geologist, v. 3, no. 4, p. 155–160, illus., table, 1966.

A highly fossiliferous calcareous interval has been discovered in the normally arkosic lower Fountain Formation of Pennsylvanian age at Perry Park, Colorado, about 35 miles south of Denver. This 20-ft-thick interval is present 250 feet above the base of the Fountain and contains a faunal assemblage represented by every major invertebrate phylum. The silicified fauna is interpreted as being of Morrowan age, thus providing evidence for an Early Pennsylvanian age for the beginning of the Ancestral Rocky Mountain orogeny.—Author's abstract

Ellsworth, N. *See* Smith, H. W. 7888

Enlows, Harold E. *See* Fernandez, Louis A., Jr. 7869

8189 **Erickson, R. L.; Marranzino, A. P.; Oda, Uteana; Janes, W. W.** Geochemical reconnaissance in the Pequop Mountains and Wood Hills, Elko County, Nevada: U.S. Geol. Survey Bull. 1198-E, p. E1–E20, illus., tables, geol. map, 1966.

Geochemical reconnaissance in the Pequop Mountains and Wood Hills has shown that anomalously high concentrations of metals (chiefly zinc, lead, and mercury) occur in iron-rich fracture fillings and in small gossan pods in silicified dolomite and limestone. The strongest anomalies detected in the Pequop Mountains and in most of the old prospects in the Wood Hills are in the Guilmette Formation and Simonson Dolomite of Devonian age. Small white barite pods and lenses are common in the Guilmette Formation. Other metal anomalies were detected in metamorphic rocks in the Wood Hills. The most successful method of geochemical reconnaissance was the analysis of float cobbles and pebbles collected in the major drainages. Conventional stream-sediment sampling and analysis failed to reveal any anomalous metal content except in drainage from the Spruce Mountain mining district at the south end of the Pequop Mountains.—Authors' abstract

8243 **Escher, Arthur.** The deformation and granitisation of Ketilidian rocks in the Nanortalik area, S. Greenland: Medd. om Grønland, v. 172, no. 9, 102 p., illus., tables, geol. map, 1966; reprinted as Grønlands Geol. Undersøgelse Bull. 59, 1966.

The Nanortalik Peninsula is composed largely of Ketilidian schist, quartzites and volcanic rocks, all folded in three phases during the Ketilidian period: first with NNE trending axes, the second essentially plastic with NW axes, and the third, fracture-cleaved, in long wavelengths with NNE to NE axes. Migmatization resulted in many dikes and veins of pegmatite and aplite, with four generations of Ketilidian pegmatites, most of them metasomatic. The schists tended to become granodioritic. In the northeast three Sanerutian granites are similar in composition, but differ in ages and textures: the first with indistinct foliation replaces volcanic rocks; the second having a coarse porphyroblastic texture, the apparent result of intrusion of a melt and subsequent replacement of host rock; the latter is characteristic of a pure intrusive body.—G.D.C.

Eyrich, Henry T. *See* Mills, Joseph W. 8000

7836 **Fagerstrom, J. A.** Biostratigraphic significance of rhipidomellid brachiopods in the Detroit River Group (Devonian): Jour. Paleontology, v. 40, no. 5, p. 1236–1238, 1966.

The upper limit of *Dalejina* is above the Amherstburg Dolomite of the Detroit River Group of the Michigan Basin, and in the Edgecliff Member of the Onondaga limestone of New York, suggesting correlation of those two units, and corroborating similar evidence from corals and from the lower limits of the range of *Rhipidomella*.—R.E.G.

7993 **Falconer, G.** Preservation of vegetation and patterned ground under a thin ice body in northern Baffin Island, N.W.T. [with French abs.]: Canada Dept. Mines and Tech. Surveys Geog. Br. Geog. Bull., v. 8, no. 2, p. 194–200, illus., 1966.

A thin ice body in northern Baffin Island is undergoing rapid recession revealing undisturbed pattern ground features and vegetation. A sample of moss thus exposed has a radiocarbon age of 330±75 years, and supports previous estimates of the occurrence of a markedly more nival period in parts of arctic Canada two to three centuries ago.—Author's abstract

8109 **Fanning, D. S.; Jackson, M. L.** Clay mineral weathering in southern Wisconsin soils developed in loess and in shale-derived till, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 175–191, illus., tables, 1966.

Loess is the dominant soil parent material covering the western and central parts of the area, and glacial till derived from Devonian shales and Silurian dolomite is most extensive in the extreme southeast. Twenty samples from four loess soils and five from two till soils were studied. Soils developed in loess are coarser, leached deeper, more acid, and contain more Zr in their coarse silt than those developed in till, also the clay contains a higher proportion of minerals of more advanced weathering indexes. Clay mineralogy of the soils developed from loess was fairly uniform. Particle-size distribution in all soils is tabulated, and X-ray diffraction patterns given.—E.S.L.

Felli, J. *See* Carr, D. D. 8244

Ferm, John C. *See* Connor, Carol Waite. 8079

7869 **Fernandez, Louis A., Jr.; Enlows, Harold E.** Petrography of the Faraway Ranch Formation, Chiricahua National Monument, Arizona: Geol. Soc. America Bull., v. 77, no. 9, p. 1017–1030, illus., tables, 1966.

The Faraway Ranch Formation consists of volcanic and sedimentary rocks of Oligocene to middle Miocene age. In the northern Chiricahua Mountains in southeastern Arizona the formation has been subdivided into nine members with a total thickness of 1,375 feet. Five of the members are pyroclastic rocks, two are flows, and two are fluviatile sandstones and fanglomerates derived from nearby volcanic rocks. The pyroclastic rocks are predominantly rhyolitic ash flow tuffs, but one member is a basalt breccia. The flows are composed of rhyodacite and basalt. Several angular unconformities are found within the sequence. The character of the sedimentary rocks suggests that the topography and climate during deposition were similar to that existing at present.—D.H.W.

7980 **Finney, J. J.** The unit cell of tarbuttite, $Zn_2(PO_4)(OH)$, and paradamite, $Zn_2(AsO_4)_2(OH)_2$: Am. Mineralogist, v. 51, no. 7, p. 1218–1220, illus., table, 1966.

Unit cell data are given for tarbuttite and paradamite.—E.H.R.

8074 **Fischer, William A.; Davis, Dan A.; Sousa, Theresa M.** Fresh-water springs of Hawaii from infrared images: U.S. Geol. Survey Hydrol. Inv. Atlas HA-218, scale about 1 in. to 8 mi., illus., table, text, 1966.

Discharge of water from Hawaii Island consists of ground-water flow at sea level from rock along the shore, flow in perennial streams, and occasional flow in ephemeral streams. Most ground water discharge at sea level is diffused along rocky shores exposed to waves; consequently flow can be measured at only a few places and many springs have gone unrecognized. Data gathered for this study included

airborne, surface temperature measurements, and ground-water discharge and its relation to thermal anomalies. Infrared images show numerous features that contrast in apparent temperature with the surrounding ocean; pattern of the features and their thermal contrast with adjacent ocean waters suggest they result from spring discharge of fresh, relatively cool or relatively warm ground water into the ocean. Measurements of image tone (apparent temperature) and of size of anomalies were methods used in the study.—M.C.M.

8149 **Fitch, F. W.; Anders, Edward.** Observations on the nature of the "organized elements" in carbonaceous chondrites: Natl. Acad. Sci.—Natl. Research Council Pub. 1296A, p. 29–47, 1966.

Evidence is not adequate to suggest an extraterrestrial biological origin for the particles found in the carbonaceous chondrites. The particles with highly structured morphology are not seen in thin sections, resemble common terrestrial contaminants, and are less numerous than the simpler type. The particles of simpler morphology which do not fluoresce, either do not stain or stain atypically with biological stains, and are soluble in acids, seem to be of an inorganic composition and origin. Kimberlite stains similar to the meteorite with Feulgen and with Methyl Green whether previously treated with periodic acid or not.—D.E.B.

8023 **Fitzhugh, Edward F., Jr.; Seidel, Don C.** Formation of nickel and iron sulfides from silicates at moderate temperatures [abs.]: Econ. Geology, v. 61, no. 7, p. 1300, 1966.

8032 **Folinsbee, Robert E.; Krouse, R.; Sasaki, A.** Sulfur isotopes and the Pine Point lead-zinc deposits, Northwest Territories, Canada [abs.]: Econ. Geology, v. 61, no. 7, p. 1307–1308, 1966.

Forbes, R. B. *See* Wilson, C. R., 7937

8033 **Fournier, Robert O.; Rowe, Jack J.** Estimation of underground temperatures in hot spring systems from the silica content of hot spring and geothermal well waters [abs.]: Econ. Geology, v. 61, no. 7, p. 1299, 1966.

7905 **Fox, Richard D.** Geology and ground-water resources of the Cascade-Ulm area, Montana: Montana Bur. Mines and Geology Bull. 52, 64 p., illus., tables, geol. map, 1966.

Outcropping rock units here include 35 feet of Jurassic siltstone and 2,300 feet of Cretaceous sandstone, siltstone and shale. The Morrison Formation is disconformably overlain by the Kootenai, Blackleaf, Marias River, Telegraph Creek and Virgelle formations. Igneous rocks of Tertiary age include the Adel Mountain Volcanics and dikes and sills. Gentle westward dips in the north reflect the Sweetgrass Arch; in the south, folds and reverse and high-angle faults postdate igneous intrusion. Quality of ground water is good, and most of the production is from the Blackleaf aquifers; alluvial deposits along the Missouri River yield adequate supplies at shallow depth. The Virgelle aquifer is excellent but limited in extent; some springs occur in other sandstone units.—G.D.C.

Frankenberg, Dirk. *See* Pilkey, Orrin H. 7939

Fredriksson, Kurt. *See* Boström, Kurt. 7960

French, R. R. *See* Carr, D. D. 8244

7799 **Freund, Hugo.** (editor). Applied ore microscopy—Theory and technique (1st English edition): New York, Macmillan Co., 607 p., illus., tables, 1966.

This book is extracted from the multivolume 'Handbuch der Mikroskopie in der Technik' (1954). Eight chapters dealing with ore microscopy were selected, translated, and assembled in unabridged form. The volume is dedicated to Paul Ramdohr, and three chapters are written by him. Seven of the chapters are cited individually.—E.S.L.

Friedman, I. *See* Graf, D. L. 8218

8150 **Friedrich, G. H.; Hawkes, H. E.** Mercury dispersion halos as ore guides for massive sulfide deposits, West Shasta district, California [with German abs.]: Mineralium Deposita, v. 1, no. 2, p. 77–88, illus., tables, 1966.

In the West Shasta district, California, flat-lying deposits of massive pyrite containing chalcopyrite, sphalerite, galena, and tetrahedrite occur within a section of unmineralized rhyolites and tuffs. Mercury was determined in residual soils derived from apparently unmineralized rocks at stratigraphic levels from 50 to 200 feet over known ore at the Early Bird, Keystone, and Mammoth mines. In each case, pronounced mercury anomalies were found. The mercury content of anomalous soils ranges up to 340 ppb (parts per billion, 10^{-9}g/g) over a background of 20 to 60 ppb.—Authors' abstract

7794 **Friedrich, Otmar.** The history of ore microscopy, *in* Applied ore microscopy—Theory and technique (1st English edition): New York, Macmillan Co., p. 1–27, illus., 1966.

The first microscopic observations were made about 300 years ago, with a magnifying glass. In 1783 Lieberkühn developed a mirror by which opaque material could be studied. Meteoritic iron was the first mineral to excite general interest, and was studied by von Widmanstätten. The first student of ore microscopy was Berzelius in 1814, and the metallographic microscope gained general acceptance around 1865. Campbell and Knight can be considered as the founders of applied ore microscopy on the basis of results of their studies of Sudbury ore in 1906–07, but the first textbook was not written until 1916 (Murdoch). The work of Schneiderhöhn is reviewed. Berek was the leading personality in the development of theoretical background and construction of equipment. Americans have been particularly interested in polishing and grinding techniques.—E.S.L.

8329 **Friedrich, Otmar.** Microscopic investigation of the iron ore minerals and of the more important minerals of the steel alloy metals, *in* Applied ore microscopy—Theory and technique (1st English edition): New York, Macmillan Co., p. 381–437, illus., tables, 1966.

The iron-ore minerals, magnetite, hematite, limonite, and siderite are described from different types of deposits, and illustrated by polished sections. Gangue minerals and iron silicates are described also, leading up to a section on beneficiation. Manganese ores, because of their complex nature and fineness of grain, are one of the most difficult groups of minerals for polished section study; the ore minerals are tabulated. Chromite and the few minerals considered as ores of titanium are described and illustrated. Four color photographs of polished sections are included.—E.S.L.

8166 **Fritz, M. A.** *Diplotrypa schucherti*, a new bryozoan species from the Long Point Formation (Ordovician), western Newfoundland: Jour. Paleontology, v. 40, no. 6, p. 1335–1337, illus., 1966.

Schuchert and Dunbar (1934) described from a small reef in the Long Point Formation (Middle Ordovician) of western Newfoundland a massive colonial organism, 3 feet in diameter, which the authors referred to the genus *Monotrypa* Nicholson. Because this size seemed excessive for a bryozoan I began a study, through the courtesy of the Peabody Museum of colonial forms from the above-mentioned reef. Although no species of *Monotrypa* has yet turned up in my investigation, a new species of *Diplotrypa* Nicholson has been identified and is described herein as *Diplotrypa schucherti*.—Author's abstract

8249 **Frohberg, M. Hans.** Beitrag zur Kenntnis der Zinnvorkommen am Mount Pleasant in der Provinz Neubraunschweig, Kanada: Bergakademie, v. 18, no. 8, p. 455–460, illus., 1966.

The tin occurrences discovered in 1964 at Mount Pleasant, in southwestern New Brunswick, under a thick glacial cover are situated at the southern margin of a geosyncline striking N.E.–S.W. within a volcanic complex saturated with various

porphyries. The mineralization is mainly connected with tectonic zones and consists of three sequences, the first of which shows pneumatolytic features. Of an essentially younger age is a second, mainly sulphidic sequence, with pronouncedly hydrothermal characters. Youngest formations must be mainly regarded as kaolinite and hydromuscovite.—Author's abstract.

Frondel, Clifford. *See* Fuchs, Louis H. 7884

7973 **Frondel, Clifford; Ito, Jun.** Hendricksite, a new species of mica: Am. Mineralogist, v. 51, no. 7, p. 1107–1123, illus., tables, 1966.

Hendricksite is a new species of trioctahedral mica, representing the Zn member of the group. It occurs abundantly at Franklin, N. J. The studied material represents a solid solution extending from slightly zincian and manganoan varieties of phlogopite up to material in which the octahedral positions are occupied by Zn 50 and Mn 40 in atomic percent with the balance Mg, Fe^{2+} and Fe^{3+}. Most of the material represents the 1M polytype. A few examples of the M_1 and 3T polytypes and of unidentified polytypes and interstratifications, in part random, were recognized.—*from* Authors' abstract

7884 **Fuchs, Louis H.; Frondel, Clifford; Klein, Cornelis, Jr.** Roedderite, a new mineral from the Indarch meteorite: Am. Mineralogist, v. 51, no. 7, p. 949–955, tables, 1966.

The new mineral roedderite, $(Na_{1.10}K_{0.69})_{1.99}(Mg_{4.86}Fe_{0.27})_{5.13}(Si_{11.88}Al_{0.07})_{11}$ has been found as an accessory in the enstatite chondrite, Indarch. The assemblage in which it occurs consists of enstatite, clinoenstatite, troilite, and nickel-iron. X-ray studies of the roeddeeite established it to be isostructural with osumilite and merrihueite. Electron probe analyses, indexed X-ray diffraction pattern, unit cell dimensions, and optical data for roedderite are presented.—*from* Authors' abstract

Fullagar, Paul D. *See* Bottino, Michael L. 7990

7793 **Fyfe, W. S.; Turner, Francis J.** Reappraisal of the metamorphic facies concept: Contr. Mineralogy and Petrology, v. 12, no. 4, p. 354–364, illus., 1966.

Eskola's concept of metamorphic facies is reappraised in light of current knowledge and usage. Mutual boundaries between facies are transitional. The authors propose henceforth not to recognize subfacies. Eleven facies are recognized in this paper, and their terminology adapted to current usage: A. low-pressure facies, commonly contact—1. albite-epidote-hornfels, 2. hornblende-hornfels, 3. pyroxene-hornfels, 4. sanidinite; B. high-pressure low-temperature facies, regional—5. zeolitic, 6. greenschist, 7. glaucophane-lawsonite-schist; C. high-pressure medium- to high-temperature facies, regional—8. albite-epidote amphibolite, 9. amphibolite, 10. granulite; and D. facies of extreme pressure and wide temperature range—11. eclogite.—*from* Authors' abstract

7874 **Fyson, W. K.** Structures in the Lower Paleozoic Meguma Group, Nova Scotia: Geol. Soc. America Bull., v. 77, no. 9, p. 931–943, illus., table, 1966.

Slates, schists, and quartzites from the Lower Paleozoic Meguma Group that covers much of mainland Nova Scotia have been deformed at least three times. The first and major deformation produced, in the early Middle Devonian(?), regional folds of northeast to east trends. The second generation of folds (F_2) are mainly small scale folds, typically interstratal, angular, and Z-shaped in profile. The F_2 axial planes strike northward and predate the granites and contrast with the F_3 folds, which are S-shaped kinks of northwest strike that generally postdate the granites. There is some evidence for pre-granite S-kinking and sinistral faulting.—R.G.Y.

Gates, W. J. *See* McFarlane, P. 8042

8145 **Gaudette, H. E.; Eades, J. L.; Grim, R. E.** The nature of illite, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 33–48, illus., tables, 1966.

Chemical composition, X-ray diffraction and other analytical data of a series of samples of clays that are composed essentially of illite are presented. The physical properties of these samples are given and related to variations in the composition and character of the illites. Data indicate that these illites have less potassium than well-crystallized micas and some of them are not essentially mixed-layer structures. It is concluded, therefore, that illite is not necessarily a mixed-layer material. Authors' abstract

Gauri, K. L. *See* Boucot, A. J. 7837

8220 **Geiger, K. W.; Brown, R. E.; Withers, D. W.; deVries, P. H.** Water-well records, southern Alberta—Townships 1–10 (complete to December 31, 1964): Research Council Alberta Prelim. Rept. 65-4, 131 p., illus., tables, 1966.

Water-well records are an important source of near-surface geological and hydrological information. Most of the records presented here have not been published previously in any form. They represent a complete record of all the water-well data in the Groundwater Division's files to the end of December 1964, and include that part of Alberta from the United States border to township 10 inclusive. They should be of considerable use for the evaluation of the natural resources of southern Alberta. A description of the system of land division and a list of licensed water-well drilling contractors is included.—*from* Authors' abstract

8330 **Geological Association of Canada; Mineralogical Association of Canada; Poole, W. H.** (editor). Geology of parts of Atlantic Provinces—Guidebook, Sept. 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], 155 p., illus., tables, 1966.

The 14 papers (cited separately) and 8 field trips in the volume describe the geology of some of the more interesting parts of New Brunswick, Nova Scotia, and Newfoundland.—E.S.L.

7954 **Geological Society of America.** (Southeastern Section). Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Guidebook, Field Trip 1, April 1966: Athens, Ga., Univ. Georgia Dept. Geology, [156] p., illus., tables, 1966.

The Holocene and Pleistocene barrier islands are juxtaposed on Sapelo Island, and the resulting modern beach and marsh deposits, and complex dune-ridge systems are described. Structural beach features are stratification, ripple marks, and burrows. In places salt-marsh deposits are exposed by erosion. Pleistocene soil profiles are given and C-14 dates applicable to sea-level elevations 20,000 to 50,000 B.P. are tabulated. Five papers and twelve reprints (from the University of Georgia Marine Institute Collected Reprints) supplying background information are cited separately.—E.S.L.

8070 **Geological Society of America.** (Bibliographic Staff). Annotated bibliography of economic geology for January-June 1965, V. 38, No. 1: Urbana, Ill., Econ. Geology Publishing Co., p. 1–171, 1966.

7887 **Gerard, C. J.; Cowley, W. R.; Kunze, G. W.** Influence of drying conditions on noncapillary porosity: Soil Sci., v. 102, no. 1, p. 59–63, illus., 1966.

Slow drying of soils at 27°C and relative humidity of 80 percent decreased noncapillary porosity and increased soil strength, as compared to more rapid drying in a forced draft oven at 50°C. Slow drying is probably the primary factor which causes indurated layers of reduced permeability in virgin soils of the lower Rio Grande valley of Texas. Slow drying would also contribute to reduced permeability and increased strength in cultivated soils.—J.W.H.

8331 **Gibbs, G. V.** The polymorphism of cordierite—[Pt.] 1, The crystal structure of low cordierite: Am. Mineralogist, v. 51, no. 7, p. 1068–1087, illus., tables, 1966.

Low cordierite refined by 3D least-squares and Fourier methods, has an ordered framework structure in which Al- and Si-rich tetrahedra are in perfect alternation in all directions except for two Si-rich tetrahedra that share a common oxygen atom in the six-membered ring. The Si- and Al-rich tetrahedra have mean T–O bond

lengths of 1.614 and 1.748 A, respectively. The ordered nature of the tetrahedral atoms in low cordierite shows that any consideration of the disorder–order transformation must take into account the framework with its four Al- and five Si-atoms. Weak, broad peaks of electron density suggest that the channel atoms (molecular water, alkaline earth and alkali metal atoms) are randomly distributed at the periphery of the large cavity rather than fixed at its center.—*from* Author's abstract

Gile, Leland H. *See* Hawley, John W. 7802

7955 **Giles, Robert T.** River, beacn and dune sands of the southeastern Atlantic coast of the United States, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, p. 71–76, illus., table, 1966.

The composition, source, and sorting characteristics of beach, dune, and river sediments were surveyed from analyses of 53 beach, 50 dune, and 40 river samples, collected from Cape Hatteras, N. C. to Miami Beach, Fla. Diagrams of carbonate content for beach and dune sands are very similar. Non-opaque heavy minerals from Coastal Plain rivers and Florida beaches and dunes are tabulated. Grain sizes are finest on the Georgia coast and carbonate content less, with coarser grain to the north and south; the carbonate content in Florida is very high.—E.S.L.

8261 **Giletti, Bruno J.** Isotopic ages from southwestern Montana: Jour. Geophys. Research, v. 71, no. 16, p. 4029–4036, illus., tables, 1966.

Potassium-argon and rubidium-strontium age measurements for the southwest Montana basement show that a regional metamorphism occurred 1.6±1 b.y. ago and was accompanied by igneous intrusion (Dillon granite gneiss). The southeastern margin of the metamorphism is found in the Gravelly Range and the Gallatin River canyon. Rocks to the southeast of the margin yield ages from 2.1 to 3.2 b.y. Some of the gneisses in the 1.6-b.y. terrane may be 3.1 b.y. old. The Laramide Boulder and Tobacco Root batholiths sharply reduced the isotopic ages of the Precambrian rocks they intruded in a narrow belt around their contacts. Deposition of the Belt series postdates the 1.6-b.y. age.—Author's abstract

Gillespie, E. L. *See* McGavock, E. H. 8210

8072 **Gilluly, James.** Volcanism, tectonism, and plutonism in the western United States—Reply [to discussion by L. D. Ramspott, 1966]: Geol. Soc. America Bull., v. 77, no. 6, p. 667–669, 1966.

Admission is made that some western plutons may well be of Paleozoic age and previous discussion was too restrictive. Main thesis remains that plutonism during this time was relatively minor and that the geologic record of the western United States shows no significant nor necessary correlation between plutonism and orogeny.—J.J.H.

Goddard, Edwin N. *See* Kelly, William C. 8035

8155 **Goldsmith, Victor.** Recent sediments of Choctawhatchee Bay as an indicator of sea level changes: Coastal Research Notes, v. 2, no. 2, p. 11–12, 1966.

The bay is a nearly enclosed estuarine-lagoon complex bordering the Gulf of Mexico in west Florida, and separated from the Gulf by a barrier spit. Extensive bottom sampling, sub-bottom profiles, and C-14 dating have revealed a dramatic change in the recent sedimentary environment. Very fine-grained sediment covers most of the bay; the western end and a shoal ringing the inner margin contain sand. Salinity profiles indicate intense stratification. Low alkalinity and highly reducing conditions explain the lack of macroscopic shell material. Bottom profiles reveal two other layers—an 8–12 feet thick layer of large shells dated at 3,300 B.P., and a broad concave upward shape stretching across the bay and connecting with the shoal. Basal sands were deposited when sea level rose rapidly, 20,000 to 7,000 B.P. From 7,000 to 3,000 B.P. sea level rose slowly and the barrier spit formed, ending the prolific shell life.—E.S.L.

8086 **Goode, Harry D.** Second reconnaissance of water resources in western Kane County, Utah: Utah Geol. and Mineralog. Survey Water-Resources Bull. 8, 44 p., illus., tables, 1966.

Supplies of ground water in bedrock in western Kane County occur in the Shinarump Member of the Chinle Formation, in two members of the Navajo Sandstone, in several sandstones of Late Cretaceous age, and possibly in the Wasatch Formation. The best potential aquifer for extended development of water, such as would be needed to develop the extensive coal deposits of the Kanab field, is the Navajo Sandstone. If the recoverable ground water is as much as the 10 million acre-feet estimated, the aquifer could yield 100,000 acre-feet a year for a long period, despite the low annual recharge of 30,000 to 60,000 acre-feet. Basic data given include: records of 89 springs and 14 wells, drillers' logs of 9 wells, and 48 chemical analyses of spring, well, and surface waters.—H.D.G.

Gordon, D. C. *See* Lundy, B. R. 8073

8251 **Gordon, E. Kent; Samson, Sten; Kamb, W. Barclay.** Crystal structure of the zeolite paulingite: Science, v. 154, no. 3752, p. 1004-1007, illus., table, 1966.

Paulingite, a zeolite, has a framework structure consisting of 2016 atoms (672 silicon or aluminum and 1344 oxygen) which are in a cubic cell with an edge of length 35.093 A. The framework has several features in common with the synthetic zeolites Linde A and ZK-5; the main channels are of similar size. We have also located most of the cations and water molecules inside the framework.—Authors' abstract

7838 **Gordon, Mackenzie, Jr.** An Upper Triassic bactritoid cephalopod from California: Jour. Paleontology, v. 40, no. 5, p. 1220-1222, illus., 1966.

Bactritoidea were thought to be extinct after the Permian, but this new genus and species from the Hosselkus Limestone, Shasta County, Calif., *Dillerites shastensis*, is ribbed like *Lobobactrites*, the Devonian genus from which ammonoids are thought to be derived.—R.E.G.

7965 **Gott, Garland B.; McCarthy, J. Howard, Jr.** Distribution of gold, silver, tellurium, and mercury in the Ely mining district, White Pine County, Nevada: U.S. Geol. Survey Circ. 535, 5 p., illus., 1966.

In the Ely district, Nevada, gold, silver, tellurium, and mercury are distributed in zones clearly related to centers of alteration that are in turn related to the major copper deposits there. Recognition of similar zoning patterns elsewhere may be useful in exploring for ore deposits resembling those at Ely. Locally, gold, silver, and tellurium are present in concentrations high enough to warrant further investigation or exploration in themselves. The district constitutes one of the largest occurrences of tellurium known in the United States.—Authors' abstract

7855 **Gould, Stephen Jay.** Allometry in Pleistocene land snails from Bermuda—The influence of size upon shape: Jour. Paleontology, v. 40, no. 5, p. 1131-1141, illus., 1966.

Increased size modifies shape, with proportions described by $y = bx^k$. High values of k limit size increase, but k may decrease in larger sizes, expanding the size limitation. *Poecilozonites dalli* Sayles is a size variant of *P. cupula* Sayles. Examples of negative correlation of size and k are presented from Brachiopoda, Crustacea, Insecta, Vertebrata and fluviatile ripples.—R.E.G.

8218 **Graf, D. L.; Meents, W. F.; Friedman, I.; Shimp, N. F.** The origin of saline formation waters—[Pt.] 3, Calcium chloride waters: Illinois Geol. Survey Circ. 397, 60 p., illus., tables, 1966.

The latitude dependence of deuterium content in formation waters from the Alberta, Michigan, and Illinois basins, and the Gulf Coast establishes the fresh-water origin of the present water molecules but does not explain the origin of the dissolved solids. Two simple models for deriving typical saline water compositions, by shale ultrafiltration of the dissolved solids in different quantities and proportions of fresh

and sea water, indicate that the dissolved solids of the Illinois basin are derived from original sea water, the ionic balance little altered by fresh water. More rapid circulation of fresh water in Ca-rich brines of the Michigan basin is consistent with much steeper hydraulic gradients since Silurian time; the possible Ca supply from bedded anhydrite and gypsum is indeterminate. Some 400 new total dissolved solids determinations on the Illinois basin brines are tabulated.—G.D.C.

8117 **Grant, Willard H.** Kaolinite stability in the central Piedmont of Georgia, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 131–140, illus., 1966.

Weathered profiles, from fresh rock to the surface, in granitic rocks and biotite-plagioclase gneiss were studied. The particle size and amount of kaolin increase away from the fresh rock to a maximum in the upper saprolite or lower B horizon, and then decline sharply in the A horizon. This decline is attributed to solution of kaolin, as is an increase in proportion of gibbsite in the A horizon. The data indicate that kaolin forms, grows, and is stable in saprock, saprolite, and B horizon, but is not stable in the upper B and A horizons, or in the environment of incipient weathering. The high proportion of gibbsite in the saprock and lower saprolite is attributed to its early formation.—E.S.L.

7963 **Greaves, Jean.** Some aspects of modern barrier beach development, Sapelo Island, Georgia, U.S.A., *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, p. 40–63, illus., tables, 1966.

The study covers a three-mile stretch of beach at the southeast end of Sapelo Island, Ga. It is backed by modern dunes, and is 500 feet wide at low tide. Beach profiles were surveyed on a daily and weekly basis across seven sections for a six-week period in 1964; sand samples were collected along each profile, and a fluorescent tracer study was run. The beach is in a low-energy environment and is characterized by two zones—ridge and runnel, and accretion. There is a year round net sand drift to the south.—E.S.L.

8039 **Greiner, H. R.; Potter, R. R.** Silurian and Devonian stratigraphy, northern New Brunswick [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 19–29, illus., 1966.

Silurian strata in northern New Brunswick include sandstone, siltstone, shale, and limestone, in places highly fossiliferous, and the overlying rhyolitic and andesitic flows, several thousand feet thick, with minor conglomerate, sandstone, and shale. Recent work does not support the interpretation that the Devonian rests unconformably on the Silurian. The lowermost Devonian includes calcareous and argillaceous strata overlain by palagonite tuff, shales, and basic volcanic rocks, which are unconformably overlain by light-colored rhyolitic flows and pyroclastic rocks. Total thickness of the Silurian and Devonian probably exceeds 7,000 feet. New formation names are given for the Pointe Verte and Charlo areas, and a correlation chart and geologic sketch maps are included.—E.S.L.

8263 **Griffith, E. G.** Geology of Saber bar, Logan and Weld Counties, Colorado: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2112–2118, illus., 1966.

The oil-productive Saber bar in northeast Colorado is a linear, north-trending barrier bar deposit of Upper Cretaceous "D" sandstone, in an area where sandstone development generally is poor. Development drilling reveals a sandstone body at least 10 miles long, about one mile wide, and as thick as 45 feet. Very likely the sand was supplied from the seaward (west) side by longshore currents. Permeability (several hundred millidarcys) increases toward the upper surface and the seaward side of the barrier bar and should exceed 500 md in future wells drilled farther seaward on the bar.—B.H.K.

8006 **Griffiths, John C.** A genetic model for the interpretive petrology of detrital sediments: Jour. Geology, v. 74, no. 5, pt. 2, p. 655–672, illus., tables, 1966.

Factors affecting the formation of detrital sedimentary rocks include source material, modifying processes such as erosion, transportation, and deposition, and finally the processes of diagenesis. If the source material, the processes, and the detrital sediment are each represented as a matrix, a mathematical model for the genesis of a detrital sediment is available which may be used for interpretive petrology. Two of the matrices must be given in order to obtain a unique solution for the third. The matrix representing the detrital sediment is reduced by means of factor analysis, which shows that some of the measured properties are redundant and that two sets of processes, sorting and diagenesis, are dominant in controlling the properties of detrital rocks.—A.T.M.

Grim, R. E. *See* Gaudette, H. E. 8145

8082 **Gupta, I. N.** Dispersion of body waves in layered media: Geophysics, v. 31, no. 4, p. 821–823, 1966.

The propagation of P and S waves is dispersive whenever the elastic medium departs from an infinite, homogeneous, isotropic, and ideally elastic medium. The dispersion effects are generally small but not always negligible. It is shown that, for propagation normal to a layered structure, shorter-period body waves travel faster than the longer-period body waves. This result is used as a possible qualitative explanation for observations left unaccounted for in several explosion and earthquake investigations.—Author's abstract

8173 **Guthrie, R. D.** Bison horn cores—Character choice and systematics: Jour. Paleontology, v. 40, no. 3, p. 738–740, 1966.

Most fossil bison taxa are based on size and shape of horn cores. Horn cores vary more widely than, for instance, teeth; but teeth cannot be used in bison classification because they show no distinct phylogenetic pattern. Due to higher variation in horn cores, large population samples would be necessary for between-group comparisons. Horn cores are genetically highly plastic. As an example of the difficulty of using horn-core characteristics as specific criteria, an examination of tabulations of 26 different characters measured by Skinner and Kaisen of four species of Alaskan fossil bison reveals a spectrum of morphological variation which falls within the accepted magnitude of variational limits of one species (*B. crassicornis*).—F.C.W.

7917 **Gutschick, Raymond C.** Bedrock geology, *in* Natural features of Indiana—Symposium, 1966 (Indiana Sesquicentennial Volume, 1816–1966): Indianapolis, Ind., Indiana Acad. Sci., p. 1–20, illus., 1966.

This paper, directed toward students of earth sciences, deals essentially with the history of Indiana before the great Pleistocene ice age and particularly with Paleozoic rocks which make up that portion of the Earth's crust down to the "basement" and crop out on the surface. Geological principles and data necessary to understand these relations are outlined. Insight is sought through graphic presentation using maps, cross-sections, and block diagrams.—G.D.C.

7972 **Güven, Necip; Kerr, Paul F.** Selected Great Basin playa clays: Am. Mineralogist, v. 51, no. 7, p. 1056–1067, illus., tables, 1966.

Mineralogical studies of samples from Deep Springs Playa, California, Mud Lake and Humboldt Playas, Nevada, Sevier Playa, Utah, and the Animas Playa, New Mexico, indicate that the mica-type clay minerals illite, vermiculite, and montmorillonite are prominent in the playa crusts. The clay minerals display strong continuous scattering accompanying the normal Bragg reflections, presumably caused by intensive structural disorder due to weathering. The existence of sensitive layers like those of vermiculite and montmorillonite in the playas is important in explaining the physical behavior of the surface of the playas. These layers exfoliate when dried and also expand with an increase in humidity.—E.Z.

Haarr, Allan P. *See* McGrew, Wesley C. 7901

7841 **Haas, Otto.** Recent literature on Mesozoic ammonites, Pt. 7: Jour. Paleontology, v. 40, no. 5, p. 1070–1081, 1966.

Literature on Mesozoic ammonites (Cephalopoda, Ammonoidea) from 1963–1965 (and a few earlier) is reviewed critically. The papers reviewed include proposals for seven new genera and four new subgenera.—R.E.G.

7872 **Hack, John T.** Circular patterns and exfoliation in crystalline terrane, Grandfather Mountain area, North Carolina: Geol. Soc. America Bull., v. 77, no. 9, p. 975–986, illus., 1966.

Large-scale arcuate, circular, and elliptical patterns developed in areas of crystalline rock in the Piedmont and Blue Ridge physiographic provinces in western North Carolina are believed to be the result of sheeting or exfoliation. On aerial photographs the patterns are defined by curved drainage lines and ridges, domical features, basins, and arcuate belts of contrasting vegetation. The circular patterns show no relationship to geologic contacts and other primary structures, but their size, density, and form vary with the rock type. Thick rock spalls as much as half a mile in diameter may form by dilation of the rock as the erosion surface is lowered. Opening of tectonic joints which facilitate formation of these circular patterns is probably dependent on exfoliation.—D.H.W.

Hagin, J. *See* Nevo, Z. 7898

7998 **Hagner, A. F.** The Precambrian magnetite deposits of New York and New Jersey [discussion of paper by A. F. Buddington, 1966]: Econ. Geology, v. 61, no. 7, p. 1291–1292, 1966.

A number of lines of evidence support the view that the gneissic host rock of the iron deposits is a product of granitization and that the iron deposits were formed by release of iron from ferromagnesian silicates during regional metamorphism. (See Buddington, ibid., v. 61, p. 484–510).—W.S.W.

7982 **Hagni, Richard D.** The preparation of thin sections of fragmental materials using epoxy resin: Am. Mineralogist, v. 51, no. 7, p. 1237–1242, illus., 1966.

Thin sections of fine fragments can be prepared by mounting in epoxy resin. The bond formed is strong and no heat treatment is needed. The index of refraction of epoxy resin with triethylene tetramine catalyst in the ratio of 10:1 is $1.591 \pm .002$.—E.Z.

Hahl, D. C. *See* Handy, A. H. 7879

7900 **Hale, Malcolm D.** Lakes and streams, *in* Natural features of Indiana—Symposium, 1966 (Indiana Sesquicentennial Volume, 1816–1966): Indianapolis, Ind., Indiana Acad. Sci., p. 91–99, illus., 1966.

Rivers of Indiana flow in all directions, as shown on a map of the drainage system; the largest, the Wabash River, drains two-thirds of the State and flows generally south into the Ohio River. The Kankakee flows westward into Illinois, and the Maumee eastward through Ohio into Lake Erie. The present pattern is changed considerably by glaciers and subsequent floods from the original pattern on the bedrock surface. The discharge, sediment load, storage of water, and management problems are summarized. The natural lakes alone store more than 240,000 million gallons of water.—G.D.C.

7853 **Hall, Clarence A., Jr.** *Archaeopneustes moorefieldi*, a new Pliocene spatangoid from the San Luis Obispo area, California: Jour. Paleontology, v. 40, no. 5, p. 1123–1126, illus., 1966.

A new spatangoid echinoid, *Archaeopneustes moorefieldi* n. sp., is described from moderately deep (150 to 300 feet) or deep water–deposited Pliocene sediments [Pismo Formation] exposed in Castro Canyon, western San Luis Obispo County, Calif. Mr. J. R. Moorefield discovered this large echinoid and kindly donated it to me. It is now in the type collection at UCLA. Although the fossil is not perfectly

preserved its unique occurrence in the Neogene stratigraphy of California warrants description.—Author's abstract

8018 **Hall, H. T.; Yund, Richard A.** Pyrrhotite phase relations below 325°C [abs.]: Econ. Geology, v. 61, no. 7, p. 1297, 1966.

Halpenny, P. C. *See* McGavock, E. H. 8210

8242 **Hambleton, William W.** New dimensions for mineral resources studies: Kansas Geol. Survey Spec. Distrib. Pub. 31, 7 p., 1966.

Techniques from geology, geophysics, statistics, engineering, and econometrics can be combined to analyze aspects of industrial minerals in a region's economy. These include refinement of methods for studying the impact, determination of projects most likely to produce maximum returns, techniques for exploration and development, methods of forecasting regional transfers of industrial minerals, and economic model building. Decisions are based ultimately on economics rather than geology and depend upon operations research and systems analysis; demands on geological education are thus demands for versatility, and for capability for transference of ideas from one field to another.—*from* Author's abstract

7879 **Handy, A. H.; Hahl, D. C.** Great Salt Lake—Chemistry of water, *in* The Great Salt Lake: Utah Geol. Soc. Guidebook to Geology of Utah, no. 20, p. 135–151, illus., tables, 1966.

Inflow to Great Salt Lake varies greatly with climatic changes. About 1870, at the highest recorded stage, the brine contained as little as 14 percent dissolved minerals in contrast to 29 percent at the lowest lake stages around 1900, 1930, and 1960. Proportion of major constituents remained the same throughout the 1850–1965 period; dissolved solids contained 85–95 percent sodium chloride. Since construction of a causeway in 1957, over 95 percent of the fresh-water inflow enters the southern part of the lake, from which mostly brine flows into the northern part. The chemical character of the brine south of the causeway remains the same, but the dissolved-solids content varies seasonally; the annual temperature fluctuation of 70°F causes winter precipitation of sodium sulfate. North of the causeway, brine contains minor dissolved solids in different proportions, possibly valuable in study of mineral migration.—G.D.C.

Handy, R. L. *See* Ho, Clara. 8114

8267 **Hansen, Alan R.** Reef trends of Mississippian Ratcliffe zone, northeast Montana and northwest North Dakota: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2260–2268, illus., table, 1966.

Algal pelletoid reef deposits comprise the main oil-productive lithologic type in the Mississippian Ratcliffe zone of the Charles Formation, northeast Montana and northwest North Dakota. These rocks were probably formed in a moderate- to high-energy environment near the central part of the Williston basin.—A.E.R.

8146 **Hansen, John; Løvborg, Leif.** På spor af sjaeldne metaller i Sydgrønland, [Pt.] 4—Beryllium-efterforskning [with English abs.]: Grønland 1966, no. 7, p. 243–256, illus., 1966.

A survey of uranium, thorium, and niobium mineralization in the Ilímaussaq alkaline complex has been extended to include a survey of beryllium mineralization, using a portable beryllometer. The dominantly nepheline syenite rocks were derived by extreme differentiation of a gabbroic parent magma. The beryllium minerals are generally found in late hydrothermal veins but also disseminated in naujaite, especially where it is albitized. The most important beryllium mineral is chkalovit; nine others are listed. Niobium minerals are in the same veins. It is suggested that in the extreme differentiation mineralizing fluids were concentrated and trapped under an impermeable roof of lavas. The beryllometer is described, and a geologic sketch map of the Ilímaussaq intrusion is included.—G.D.C.

Harbison, R. N. *See* Malloy, R. J. 7906

8268 **Harms, J. C.** Stratigraphic traps in a valley fill, western Nebraska: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2119–2149, illus., tables, 1966.

Oil production from the Cretaceous "J" interval in western Nebraska is mainly from lenticular bodies of crossbedded, fluvial sandstone in a north-trending zone of valley fill about 1,500 feet wide, 50 feet thick, and at least 20 miles long; seven fields have been discovered along this valley fill trend. Oil accumulated where valley fill crosses the axes of northwest plunging anticlines and updip escape was prevented by higher oil entry pressures in enclosing marine sediments. Some production comes from nearby marine Cretaceous sandstone but the success ratio of completion in the valley-fill is nearly 6 times better.—B.H.K.

8091 **Harper, M. L.** Joints and microfractures in Glenwood Canyon, Colorado: Mtn. Geologist, v. 3, no. 4, p. 185–192, illus., tables, 1966.

A study of fracture patterns was made in Glenwood Canyon, Colo., where it incises the White River arch. The latter is a broad, northwest-trending regional uplift created principally by Laramide deformation. The fracture study suggests correlation of major joints sets in the crystalline basement rocks with those in the Paleozoic sedimentary rocks. Quartz microfractures in both rock types have essentially the same trends as the joints. No definite correlation between Precambrian structures and the joint pattern can be shown. In addition, there seems to be no correlation between the joint pattern and Laramide folds and faults on the crest of the uplift. Price's theory of joint formation (release by fracturing of stored elastic strain energy) is suggested to account for the lack of correlation between the joint pattern and folds.—Author's abstract

8332 **Harris, Steven H.; Land, Cooper B., Jr.; McKeever, John H.** Relation of Mission Canyon stratigraphy to oil production in north-central North Dakota: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2269–2276, illus., table, 1966.

Cyclic deposition within the Williston basin in shallow seas during late Mission Canyon (Osagian) time resulted in stratigraphic relations that caused the formation of several oil accumulations in north-central North Dakota. Each cycle represents a brief eastward transgression of the sea, followed by a much longer regression westward.—A.E.R.

Harriss, Robert C. *See* Pilkey, Orrin H. 7788

8147 **Harriss, Robert C.; Pilkey, Orrin H.** Temperature and salinity control of the concentration of skeletal Na, Mn, and Fe in *Dendraster excentricus*: Pacific Sci., v. 20, no. 2, p. 235–238, illus., table, 1966.

Specimens of *Dendraster excentricus*, the common American Pacific coast sand dollar, were collected from 22 localities between Baja California and Vancouver Island. The tests were analyzed for Na, Mn, and Fe using an atomic absorption spectrophotometric technique. No direct relationships between salinity and the Na, Mn, and Fe contents were observed. Linear correlation coefficients were calculated for the relationships between composition and water temperatures. A direct relationship appears to exist between Na content and water temperature, but the Fe and Mn content exhibited no significant relationships. This study should have paleoecologic applications and shed light on the calcification process.—B.S.H.

Hart, S. R. *See* Ohmoto, H. 7999

Harter, R. D. *See* Ahlrichs, J. L. 7893

8137 **Harward, M. E.; Brindley, G. W.** Swelling properties of synthetic smectites in relation to lattice substitutions, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 209–222, illus., tables, 1966.

Synthetic clays were prepared hydrothermally at 300° to 350°C and 15,000 psi from gels with compositions calculated to give a series of octahedrally and tetrahedrally substituted, 2:1-type layer silicates. Comparisons of expanding properties showed that beidellites expanded less readily than montmorillonites upon solvation with glycerol vapor and tended to give single interlayer complexes, especially when Mg was the saturating ion. The K-saturated montmorillonites gave greater expansion than the beidellites on hydration at 100 percent r.h. The montmorillonites also exhibited greater rehydration than the beidellites after heating at 400°-500°C. Beidellite exhibits expansion intermediate between montmorillonite and vermiculite. The results of this investigation are consistent with the existence of somewhat stronger ionic attractions in beidellites than in montmorillonites.—*from* Authors' abstract

8238 **Haskell, N. A.** The leakage attenuation of continental crustal P waves: Jour. Geophys. Research, v. 71, no. 16, p. 3955–3967, illus., tables, 1966.

The leakage attenuation of short-period P-waves propagating in the continental crust is considered from an elementary ray-geometric point of view. Realistic crustal models lead to calculated leakage attenuation comparable to observed values for Nevada. Superposition of a large number of high-order P-modes is required in the modal representation of short-period crustal P-waves. The existence of the crustal P phase can be associated with a common maximum in the group velocity curves for all high-order modes.—D.B.V.

7765 **Hatch, N. L., Jr.; Chidester, A. H.; Osberg, P. H.; Norton, S. A.** Redefinition of the Rowe Schist in northwestern Massachusetts, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244-A, p. A33–A35, illus., 1966.

Hatfield, C. *See* Carr, D. D. 8244

Haun, John D. *See* Barlow, James A., Jr. 8181

Hawkes, H. E. *See* Friedrich, G. H. 8150

7802 **Hawley, John W.; Gile, Leland H.** Landscape evolution and soil genesis in the Rio Grande region, southern New Mexico—Friends of the Pleistocene, Rocky Mtn. Sec., 11th Ann. Field Conf., Aug. 1966, Guidebook: [Las Cruces, N. Mex., New Mexico State Univ.] 74 p., illus., tables, 1966.

This guidebook covering the 400 sq mi area of the Desert Project in southern New Mexico is divided into a section on geomorphology by Hawley, another on soils and soil-geomorphic relationships by Gile, and a tour guide, with 80 mi of road log and comments on 17 stops, by both authors. Eleven major geomorphic surfaces dating back to mid-Pleistocene are delineated; stepped-sequence of surfaces is shown on sections and each is described in detail. Soils are complex in nature and distribution, due to their great range in age, and the K horizon, a new master horizon for soils of prominent carbonate accumulation, is defined and divisions described. Stages in the morphological sequences of carbonate accumulation in gravelly and nongravelly materials, and convergence of the sequences, are discussed. Tables of selected data for soils and sections showing relationships are included.—E.S.L.

8223 **Hayatsu, Ryoichi.** Artifacts in polarimetry and optical activity in meteorites: Science, v. 153, no. 3738, p. 859–861, illus., 1966.

Scattered light produces spurious optical rotations of up to 80 millidegrees in commercial polarimeters. Even larger "rotations," up to 180 millidegrees, are observed when the sample simultaneously absorbs and scatters light. These effects may account for the optical activity reported in the Orgeuil meteorite.—Author's abstract

Hayes, John B. *See* Mossler, John H. 8118

Heckard, John M. *See* Bechert, Charles H. 7899

Hedge, C. E. *See* Pearson, Robert C. 7987

7805 **Hedlund, Richard W.** Palynology of the Red Branch Member of the Woodbine Formation (Cenomanian), Bryan County, Oklahoma: Oklahoma Geol. Survey Bull. 112, 69 p., illus., 1966.

The Red Branch palynological assemblage includes 74 forms of spores and pollen grains and one probable gymnospermous ovule, assigned to 45 genera and 71 species. Twenty-one species and one genus are described as new. A non-marine depositional environment is indicated for the Red Branch shales. The assemblage suggests a warm-temperate to tropical climate during which sediments were deposited in numerous, local swampy basins along the Cenomanian coastal plain. Upland floristic elements, such as the conifers, were probably derived from cooler elevated areas to the north. The closest palynologic correlation appears to be with the Cenomanian of Minnesota.—*from* Author's abstract

7946 **Heinrich, E. William; Shappirio, Joel R.** Alkali rocks and carbonatites of the Arkansas River canyon, Fremont County, Colorado—[Pt.] 3, The amethyst carbonatites: Am. Mineralogist, v. 51, no. 7, p. 1088-1106, illus., tables, 1966.

The Amethyst carbonatites in 12-Mile Park, Fremont County, Colo., are the northernmost representatives of the dike halo around the Iron Mountain-McClure Mountain alkalic complex. The deposits contain three main phases: 1) exomorphic zones of hematitized and feldspathized granite; 2) calcite-barite carbonatite; and 3) veins of amethystine quartz. The first represents a variant of fenite; the last is a variation of the late-stage silicification common in many larger carbonatites. In the carbonatite, each of several calcite generations is characterized by a distinctive minor element assemblage. The deposits appear to have been begun in the magmatic stage and were concluded in the hydrothermal.—Authors' abstract

7967 **Henderson, Bonnie C.** (editor). Directory of geoscience departments, United States and Canada (1966 edition): Washington, D. C., Am. Geol. Inst., 186 p., 1966.

The ninth in a series of directories, this edition furnishes details on 382 departments granting degrees in geoscience in 334 separate colleges and universities. Section 1 lists schools by geographic areas with information on degrees granted, faculties, course offerings and requirements; section 2 is an alphabetic index of 2,900 faculty members of the aforementioned institutions; section 3 is a listing of colleges offering some courses in geology, but not a major; section 4 is a tabular arrangement of data from departments' (of section 1) field courses; and section 5 presents information on selected scholarships and fellowships that are available.—M.C.M.

Henry, Vernon J., Jr. *See* Hoyt, John H. 7938

Henry, Vernon J., Jr. *See* Hoyt, John H. 7940

Henry, Vernon J., Jr. *See* Hoyt, John H. 8333

Henry, Vernon J., Jr. *See* Hoyt, John H. 8334

8241 **Henson, E. Bennette.** A review of Great Lakes benthos research: Michigan Univ. Great Lakes Research Div. Pub. 14, p. 37-54, illus., tables, 1966.

The presence of marine and brackish elements in the Great Lakes benthos has stimulated thought on the geologic history of the lakes and origin of the fauna. This review considers the benthos in terms of geologic time; its components are considered, and the glacially young fauna with relatively few species in the Great Lakes is compared with the rich fauna of the more ancient lakes Baikal and Ohrid. The species composition of the profundal zone is uniform in all the lakes except St. Clair; the origin, distribution, and abundance of three species—*Pontoporeia, Pesidium, and Heterotrissocladius*—are discussed. In the littoral fauna are native species, displaced during Pleistocene glaciation, which subsequently invaded the lake

basins. The profundal species are circumpolar forms introduced by proglacial lakes.—G.D.C.

Heron, S. D. *See* Otwell, W. L. 8247

7791 **Hewitt, C. H.** How geology can help engineer your reservoirs: Oil and Gas Jour., v. 64, no. 46, p. 171–178, 1966.

Geologic studies of oil reservoirs guide drilling, completion, and stimulation and aid in appraisal, primary recovery, and supplemental operations. They reveal that for sandstone bodies reservoir properties, rock properties and origins are related. Permeabilities of these bodies is related to texture, amount of silt and clay, amount and distribution of calcite cement, and zones of burrowing. Trend of sandstone bodies can be related to direction of sediment transport, angularity of pore spaces to gas/oil relative permeability, and mineralogy to water sensitivity. Examples of how reservoir characteristics are related to geology are given for the Frontier Formation and the Curtis Sandstone in Grass Creek field, Wyoming; Hoeing Sandstone in Plymouth field, Illinois; Robinson Sandstone in Robinson field, Illinois; and Bromide Sandstone in Knox Bromide field, Oklahoma.—K.A.D.

7781 **Hiss, W. L.; Hunter, H. E.** Primary orthopyroxene–spinel intergrowths in Cambrian cumulates, Wichita Mountains, Oklahoma: Oklahoma Geology Notes, v. 26, no. 9, p. 231–235, illus., 1966.

Thin sections of troctolite and olivine-bearing gabbro from the Wichita igneous complex show olivine crystals surrounded by coronas of randomly oriented anhedral grains of hypersthene, many of which contain vermicular intergrowths of spinel. Coronas range from thin shells less than 1 mm thick to aggregates of ophitic grains 2 cm in largest dimension. The large mineral grains enclose small laths of plagioclase, and the smaller grains are molded between olivine and larger plagioclase grains. Contacts between spinel and silicate minerals in the intergrowths are knife sharp, as are the contacts with the enclosed olivine and surrounding plagioclase. These relationships indicate that the coronas with hypersthene intergrowths are products of the original cooling of the magma and represent the last interprecipitate minerals to form.—B.S.H.

8114 **Ho, Clara; Handy, R. L.** Modification of Ca–montmorillonite by low-temperature heat treatment, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 353–365, illus., 1966.

Liquid limits of Ca–montmorillonite steadily decreased with increased temperature, until they reached a constant level at 450° to 500°C; plastic limit decreased slightly up to 350°C. The gradual change is in contrast to sudden major changes in weight loss, glycol retention surface area, and changes of peak intensity and breadth character after glycolation of the first diffraction maximum. Properties showing more gradual reductions with heat treatment were cation exchange capacity by NH_4Ac method, d_{001} intensity (21 A spacing) after storing at 100 percent r.h. one month and re-wetting with water, and amount of calcium exchangeable without water soaking. Previous water soaking allowed greater release of fixed Ca to 450°C. The 21.0 A peak intensity curve showed close similarity to liquid limit and plastic index curves in the low temperature range; an explanation is suggested.—*from* Authors' abstract

Hodson, Warren G. *See* Roberts, Robert S. 7959

Holden, John C. *See* Dietz, Robert S. 8105

Holland, H. D. *See* Ohmoto, H. 7999

8098 **Holser, W. T.; Kaplan, I. R.** Isotope geochemistry of sedimentary sulfates: Chem. Geology, v. 1, no. 2, p. 93–135, illus., tables, 1966.

Anhydrite, gypsum and other sulfates were sampled from a wide range of origins, differing in geological age, mineralogy, stage of evaporation, inland basin or oceanic

facies, and primary or replacement crystallization. Results confirm the general curve found by others, in which isotopic composition of oceanic sulfate varies with time on a worldwide scale. These variations can only be accomplished by large-scale transfer of sulfur to or from the shale reservoir. Excess inflow of sulfate was derived from shale sulfide by an increase of either weathering or metamorphism–volcanism, along with even larger amounts of sulfur from old evaporites. Alternatively, decrease of sulfide sedimentation is directly related to biologic activity. Isotopic evidence is symptomatic of important changes in tectonic and paleogeographical regime in Late Paleozoic and Early Mesozoic.—*from* Authors' abstract

Honea, R. M. *See* Keighin, C. W. 8025

8056 **Hooks, W. Gary.** Drainage density and drainage texture relationships in some selected fourth order drainage basins near Tuscaloosa, Alabama [abs.]: Alabama Acad. Sci. Jour., v. 37, no. 3, p. 261, 1966.

Hope-Simpson, D. *See* MacNeill, R. H. 8047

Hopkins, David. *See* McCulloch, David. 7986

Hopkins, David M. *See* Cox, Allan. 7875

8219 **Hovis, W. A., Jr.; Callahan, William R.** Infrared reflectance spectra of igneous rocks, tuffs, and red sandstone from 0.5 to 22 μ: Optical Soc. America Jour., v. 56, no. 5, p. 639–643, illus., table, 1966.

Total-reflectance measurements on a number of igneous rocks and other minerals indicate that reststrahlen features may be of use for remote probes into the nature of the surfaces of the Moon and planets. Varying particle size introduces effects such as reduced spectral contrast and in some cases new features that could lead to confusion in identification unless particle size is known. Short-wavelength reflectance measurements offer a method of determining particle size by remote measurements.—Authors' abstract

Howard, J. *See* Carr, D. D. 8244

8087 **Howard, James D.** Patterns of sediment dispersal in the Fountain Formation of Colorado: Mtn. Geologist, v. 3, no. 4, p. 147–153, illus., table, 1966.

Primary directional structures in the Fountain Formation (Pennsylvanian) were studied in an area extending from south of Canon City, Colo., to the Colorado-Wyoming boundary to determine the regional slope and position of the eastern limit of the ancestral Front Range highland during Fountain deposition. Paleocurrent readings establish 11 dispersal centers and indicate that the formation was deposited as alluvial fans radiating eastward from the Ancestral Rocky Mountains. In the vicinity of Canon City, dispersal patterns indicate a re-entrant in the trend of the ancient source area similar to the present Canon City embayment. The eastern limit of the source area, established by the position of paleo-fan apices, varies from 7 to 25 miles west of the present day mountain front.—*from* Author's abstract

7938 **Hoyt, John H.; Henry, Vernon J., Jr.** Rhomboid ripple mark, indicator of current direction and environment, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 5 p., paged separately, illus., reprinted 1966; originally published 1963.

The direction of current flow over the beach surface may be determined from the shape of rhomboid ripple marks. Characteristically these ripples are bowed in the direction of current flow and are pointed up-current. They are formed on the foreshore beach by wave backwash and by washover of low bars. The washover ripples result from thin sheets of water moving shoreward over the bars. At Sapelo Island, rhomboid ripples are best developed on slopes of 1/2° to 2°. The beach material is predominately fine sand. There is a direct relation between the length-width ratio of rhomboid ripples and the slope of the beach surface.—Authors' abstract

7940 **Hoyt, John H.; Henry, Vernon J., Jr.** Development and geologic significance of soft beach sand, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 8 p., paged separately, illus., table, reprinted 1966; originally published 1964.

A sponge-like, bubble development present in the upper beach surface of some stretches of the southeastern Atlantic Coast is responsible for the soft, yielding surface of the affected areas. Bubbles are formed by air trapped in sand by the rising tide. The air remains in the sand as bubbles which tend to enlarge with repeated draining and flooding. Eolian deposits on the upper beach are particularly susceptible due to the large proportion of air they contain. Bubble depressions developed on the surface are more readily preserved than bubbles, and resemble raindrop impressions. The process of formation and compaction of bubbles results in disruption of the laminae, and affects orientation of elongate grains. All of these alterations in the original properties of the sand provide environmental information.—*from* Authors' abstract

7943 **Hoyt, John H.; Weimer, Robert J.** Comparison of modern and ancient beaches, central Georgia coast, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 3 p., paged separately, illus., reprinted 1966; originally published 1963.

The modern beach on the central Georgia coast was trenched to reveal stratification, and the Pleistocene beach was surveyed along a natural channel; burrows, stratification, and grain size were studied in both. These structures should be useful in stratigraphic interpretation of other beaches. Problems in reconstructing shoreline positions resulting from sea-level changes are reviewed.—E.S.L.

7944 **Hoyt, John H.** High-angle beach stratification, Sapelo Island, Georgia, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 3 p., paged separately, illus., reprinted 1966; originally published 1962.

Foreshore sand bars at Sapelo Island typically have a steep landward slope. Deposition on this slope results in landward movement of the bar. The deposits are characterized by high-angle cross-stratification with dips as steep as 30 degrees.—Author's abstract

8333 **Hoyt, John H.; Henry, Vernon J., Jr.** Significance of inlet sedimentation in the recognition of ancient barrier islands, *in* Pleistocene and Holocene sediments, Sapelo Island, Ga., and vicinity—Geol. Soc. America SE Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 5 p., paged separately, illus., reprinted 1966; originally published 1965.

The Georgia barrier-island system is described with emphasis on the inlets and longshore currents as an aid to recognition of ancient barrier systems and shorelines. A barrier-island inlet model is proposed based on observed conditions of the Georgia coast. Profiles and sections are included.—E.S.L.

8334 **Hoyt, John H.; Weimer, Robert J.; Henry, Vernon J., Jr.** Late Pleistocene and Recent sedimentation, central Georgia coast, U.S.A., *in* Pleistocene and Holocene sediments, Sapelo Island, . . . vicinity—Geol. Soc. America SE Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 7 p., paged separately, illus., reprinted 1966; originally published 1964.

During the middle and late Sangamon interglacial a series of barrier islands developed—the Pamlico, Princess Anne, and Silver Bluff shorelines, successively younger and lower seaward. Following the lowering of sea-level during the Wisconsin, and subsequent rise, a Recent barrier island formed in front of the Silver Bluff. Sediments associated with these four shorelines are described, and divided into barrier island, tidal inlet, and salt marsh types.—E.S.L.

Hoyt, John R. *See* Weimer, Robert J. 8338

8060 **Hriskevich, M. E.** Stratigraphy of Middle Devonian and older rocks of Banff Aquitaine Rainbow West 7-32 discovery well, Alberta: Bull. Canadian Petroleum Geology, v. 14, no. 2, p. 241-265, 1966.

For the Rainbow area of Alberta, it is proposed that the Middle Devonian Keg River Formation be divided into the Lower Keg River Member, the Upper Keg River Member, and the Rainbow Member, in ascending order. The overlying Middle Devonian Muskeg Formation is divided into a lower, Black Creek Member, and an upper unnamed member. The Rainbow Member is named for biohermal reefs, 756 feet thick in the discovery well. Oil and gas are produced from the Rainbow Member of the Keg River and the upper member of the Muskeg, and gas was encountered in three other zones, one of which is noncommercial, in this well.—C.A.S.

Hsieh, J. *See* Bisal, F. 7844

Hughes, O. L. *See* Vernon, Peter. 8192

7839 **Hunt, Allen S.** Submarginal suture and ventral plate on an agnostid trilobite: Jour. Paleontology, v. 40, no. 5, p. 1238-1240, illus., 1966.

Silicified specimens of *Trinodus elspethi* (Raymond) from the Edinburg Limestone of Virginia have a submarginal plate of unknown function, which is rarely preserved, but which may be a normal feature of agnostids.—R.E.G.

Hunter, H. E. *See* Hiss, W. L. 7781

Ingalls, Arthur L. *See* Dobrin, Milton B. 8151

8196 **Ingle, James C., Jr.** Developments in sedimentology—[V.] 5, The movement of beach sand—An analysis using fluorescent grains: Amsterdam, London, New York, Elsevier Publishing Co., 221 p., illus., tables, 1966.

This report describes results of an enlarged 18-month program of sand tracing on five southern California beaches, using the fluorescent technique together with some details of current sediment-tracing programs being conducted at the University of Southern California. Terminology of the beach environment is included in chapter 1; five more chapters deal with field and laboratory procedures, general patterns of foreshore-inshore tracer transport, sand movement seaward of the breaker zone, sand movement around man-made structures, and analysis of tracer dispersion. These are summarized in chapter 7. Appendices outline dyeing techniques; summarize wave, current, and wind data and sedimentary parameters; and give conversion factors.—G.D.C.

Ito, Jun. *See* Frondel, Clifford. 7973

Jackson, M. L. *See* Fanning, D. S. 8109

8139 **Jacobs, Donald G.** Use of negative sorption in studies of ion fixation by hydrobiotite, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 341-350, illus., tables, 1966.

The response of hydrobiotite from Traveler's Rest, South Carolina to cesium fixation indicates that two distinct minerals are present, biotite and vermiculite. The tendency for the two species to collapse and entrap trace quantities of cesium is related to their interlayer surface charge densities. These interlayer charge density distributions can be determined by combining the results of anion exclusion with cation exchange data as various fractions of the mixed layer minerals are opened or collapsed by chemical treatment.—mfrom Author's summary

Janes, W. W. *See* Erickson, R. L. 8189

Jenkins, Edward D. *See* McGovern, Harold E. 7846

Jenne, E. A. *See* Langston, R. B. 8121

8012 **Jizba, Z. V.** Sand evolution simulation: Jour. Geology, v. 74, no. 5, pt. 2, p. 734–743, illus., table, 1966.

The geological processes leading toward the development of sands can be approximated in a reasonably compact manner. A sand can be represented as a matrix with elements giving percentages of specific size fractions for mineral variations or shape factors. The geological processes can be represented as constant multiplication matrices. This purely theoretical approach can provide useful insights into actual geological processes through simulation studies.—Author's abstract

Johns, W. D. *See* Tettenhorst, Rodney. 8131

Johnson, H. S., Jr. *See* Otwell, W. L. 8247

Johnson, J. G. *See* Boucot, A. J. 7829

7861 **Johnson, J. G.** Two new spiriferid brachiopod genera from the Lower Devonian of Nevada: Jour. Paleontology, v. 40, no. 5, p. 1043–1050, illus., 1966.

Two new genera, *Dyticospirifer* and *Eurekaspirifer*, are proposed for forms known from central Nevada. *Dyticospirifer* has as its type species *D. mccolleyensis* n. sp. which is known only from the *Trematospira* zone of Oriskany (late Siegenian) age. *Eurekaspirifer* is based on *"Spirifer" pinyonensis* Meek and is restricted to its nominal zone of Emsian age in the Sulphur Spring Range. Reports of *E. pinyonensis* beyond the Sulphur Spring Range are in error—the forms proving to belong to an undescribed species of *Brachyspirifer*.—Author's abstract

Johnson, J. G. *See* Boucot, A. J. 8171

8159 **Johnson, J. Harlan.** New Mississippian algae from Alberta: Jour. Paleontology, v. 40, no. 6, p. 1385–1387, illus., 1966.

Osagian (Mississippian) limestones from Alberta, Canada, contained material representing five genera of algae, three undescribed. Taxa described here include: *Eolithoporella dawsoni*, n. gen., n. sp. (Rhodophycophyta, Solenoporaceae); *Albertaporella involuta*, n. gen., n. sp. (Chlorophycophyta, Dasycladaceae); *Orthiosiphon* sp. (Chlorophycophyta, Codiaceae).—S.H.M.

8100 **Johnson, Noye M.** Geothermometry from the thermoluminescence of contact-metamorphosed limestone: Jour. Geology, v. 74, no. 5, pt. 1, p. 607–619, illus., 1966.

Theoretical calculations, based on data from thermoluminescence of limestone near contacts with a basalt lava and basalt dike in northern Arizona, indicate an "effective magma temperature" of about 950°C, neglecting latent heat of crystallization. Depending on how little crystallization had already occurred, the actual temperature at emplacement might have been somewhere between this value and 550°C.—R.E.W.

8068 **Johnson, Ralph Gordon; Richardson, Eugene S., Jr.** A remarkable Pennsylvanian fauna from the Mazon Creek area, Illinois: Jour. Geology, v. 74, no. 5, pt. 1, p. 626–631, table, 1966.

A Middle Pennsylvanian marine invertebrate and vertebrate fauna has been found in nodules of the Francis Creek shale of the Mazon Creek area, Ill. Most of the fossils are impressions of soft-bodied forms; they include such unusual specimens as polychaete worms, jellyfish, nudibranchs, holothurians, and chitons. A wormlike fossil, *Tillimonstrum*, resembling modern bathypelagic nemerteans, is the most abundant animal in the fauna. Dominantly marine ecologic types mixed with numerous continental forms suggest a nearshore environment of deposition.—R.J.R.

Johnson, Robert B. *See* West, Terry R. 7892

Johnson, William W. *See* Cook, Kenneth L. 7831

8111 **Jonas, Edward C.; Roberson, Herman E.** Structural charge density as indicated by montmorillonite hydration, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 223–230, illus., table, 1966.

A Na-saturated Texas bentonite was fractionated into six particle-size ranges; expansion of each fraction was observed by X-ray diffraction under controlled humidity conditions ranging from 0–100 percent r.h. At all humidities, fine fractions expanded more than coarse. A single size fraction expands through a series 10 A, 12.4 A, 15.5; expansion from 10–12.4 A and from 12.4–15.5 A occurs at progressively lower relative humidities for smaller size fractions. Gradation from high resistance to expansion in coarse fractions to low resistance to expansion in fine fractions appears to be continuous. Interlayer cation density controlling resistance to expansion is dependent upon structural charge density on the silicate layer. The continuous variation of resistance to expansion that is a function of particle size is interpreted to show a corresponding continuous variation in structural charge.—*from* Authors' abstract

8127 **Jorgensen, Per.** Infrared absorption of O—H bonds in some micas and other phyllosilicates, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci. V. 25), p. 263–273, illus., 1966.

Trioctahedral 2:1 and 2:1:1 phyllosilicates, where octahedral positions are filled with Mg, have an absorption band about 3700 cm^{-1}. Substitution of Fe for Mg results in a band about 3665 cm^{-1}; two Fe most commonly substitute for two Mg in the same polyhedral group. Decreasing octahedral occupancy in the phlogopite-lepidomelane group, with increasing substitution of R^{3+} for Mg, causes bands with lower frequencies. In Li-micas where less than 50 percent of the octahedral positions are filled with Li, and the rest with Al and Fe, it seems probable that OH-groups residing in a pyramid with two Li and one Al cause a band about 3580 cm^{-1}. Combinations of two Al and one Li or one Li, one Al, and one Fe cause absorption about 3480 cm^{-1}. Dioctahedral 2:1 phyllosilicates having Al or Fe in octahedral positions cause absorption about 3620 cm^{-1}.—*from* Author's abstract

Joyner, B. F. *See* Lichtler, W. F. 7907

7977 **Kahn, J. S.; Smith, D. K.** Mineralogical investigations in the debris of the Gnome event near Carlsbad, New Mexico: Am. Mineralogist, v. 51, no. 7, p. 1192–1199, tables, 1966.

Mineralogical studies on the debris formed during the underground Gnome nuclear explosion in a salt horizon of the Salado formation near Carlsbad, N. Mex., have shown that significant quantities of olivine and kirschsteinite are present in the water insoluble fraction. Particles containing these minerals are generally strongly radioactive and suggest the minerals have had a role in localizing the radioactive fission products. The size (10–500 μ) and spherical shape of the silicate particles suggest that they were immiscible droplets in the salt melt which preferentially dissolved the fission products before crystallizing. The subsequent crystallization excluded the actinides from within the crystallites, leaving them on the crystallite boundaries.—Authors' abstract

Kamb, W. Barclay. *See* Gordon, E. Kent. 8251

7931 **Kane, Henry E.** Some aspects of the drainage geography and sedimentation of a portion of southeastern Texas: Indiana Acad. Sci. Proc. 1965, v. 75, p. 197–201, illus., 1966.

The major drainage features of this Louisiana border area of Texas are the Neches and Sabine Rivers, Sabine Lake, and Sabine Pass. The two rivers drain a combined

area, partly in Louisiana, of about 19,830 sq mi underlain by Cenozoic deposits. They discharge into Sabine Lake, and through Sabine Pass into the Gulf. All sediment is deposited in the lake, except for that diverted into two canals. The eastern shoreline of the lake is still natural, formed by Pleistocene clay, but the others have been modified by man, mostly with spoilbanks. The axis of the lake basin lies closest to the steep eastern side, and isobaths in the northern part suggest small subaqueous deltas at river mouths.—E.S.L.

Kaplan, I. R. *See* Holser, W. T. 8098

Kay, Marshall. *See* Morris, R. W. 8153

7915 **Kaye, L.** Bolton Bay sheet, Lac des Mille Lacs, Thunder Bay District: Ontario Dept. Mines Map 2104, scale 1:31,680, 1966.

8269 **Kaye, L.** Eayrs–Starnes Lakes area, west part, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P.339, scale 1 in. to 1/2 mi., text, 1966.

The Eayrs–Starnes Lakes map-area straddles a northeast-trending belt of Archean metasedimentary and metavolcanic rocks; the latter are intercalated within the metasedimentary succession and form two subparallel bands, each up to 4,000 feet thick, along the flanks of the belt. Youngest bedrocks are Keweenawan and consist of carbonate shales of the Sibley Group and diabase sills and dikes. Diabase sheets are up to 200 feet thick and form mesas covering the older Precambrian rocks in the eastern part of the area. The major structural unit is an isoclinal syncline whose limbs are the metavolcanic bands. Grab samples from quartz veins and limonitic material show trace amounts of gold and silver. No mineral production has been reported.—M.C.M.

8270 **Kaye, L.** Eayrs–Starnes Lakes area, east part, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P.340, scale 1 in. to 1/2 mi., text, 1966.

The text for the Eayrs–Starnes Lakes area is abstracted for Map P.339 (Kaye, 1966).—M.C.M.

8025 **Keighin, C. W.; Honea, R. M.** Phase relations in the system Ag–Sb–S [abs.]: Econ. Geology, v. 61, no. 7, p. 1302–1303, 1966.

8065 **Keller, George V.** Electrical properties of rocks and minerals, Sec. 26 *in* Handbook of physical constants (revised edition): Geol. Soc. America Mem. 97, p. 553–577, illus., tables, 1966.

The *dielectric constant and conductivity* of rocks and minerals are defined here. Materials are classified as conductors, semiconductors or insulators. Resistivities reported in the literature for individual minerals and elements are tabulated; no data are available for common rock-forming silicates, which are insulators. Other tables summarize ranges of water-bearing rocks, coefficients of macroanisotropy, equations relating resistivity and porosity for fully water-saturated rocks, resistivities of natural waters, conductivity of ice, behavior of D.C. conductivity in igneous rock types at high temperatures, temperature dependence of resistivity in various rocks near O°C, and dielectric constants of minerals, rocks, and soils. Selected curves are presented.—G.D.C.

7889 **Keller, J.; Alfaro, J. F.** Effect of water application rate on leaching: Soil Sci., v. 102, no. 2, p. 107–114, illus., 1966.

The effect of water application rate on leaching efficiency was studied using a single soil and salt at several salt and initial soil moisture levels. The shapes of the effluent concentration curves suggest that leaching efficiency is improved by decreasing the application rate. The work demonstrated the phenomenon of miscible displacement, when the effect of water-flow rate coupled with the degree of soil saturation are interrelated and dependent upon the application rate. Furthermore, the initial soil water content and the water content throughout the transmission zone during leaching differ greatly.—J.W.H.

8134 **Keller, W. D.; McGrain, Preston; Reesman, A. L.; Saum, N. M.** Observations on the origin of endellite in Kentucky, and their extension to "indianaite", *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 107–120, illus., tables, 1966.

Endellite is being formed south of Stanford, Ky., in an acid environment. Parent materials are principally a weathered residuum, derived presumably from the Brassfield Limestone that lies between the illitic, Devonian New Albany Shale and illitic, Ordovician Richmond Shale, and added Si and Al dissolved from the New Albany Shale. Source of acid is weathering iron sulfide in the New Albany. Apparent standard free energies of formation indicate that essentially equilibrium conditions developed between the endellite, the illite of the New Albany Shale, and the permeating solution. It is suggested that Indiana endellite was formed at the Mississippian–Pennsylvanian unconformity in an environment similar to that yielding the Kentucky endellite.—*from* Authors' abstract

8050 **Kelley, D. G.** Stratigraphy of Cape Breton Island [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 115–130, illus., table, 1966.

Cape Breton Island, Nova Scotia, is underlain by rocks ranging in age from Precambrian to Mississippian. The Precambrian includes the metasedimentary George River Group, and the younger volcanic Fourchu Group. Middle Cambrian fossiliferous strata are intercalated with igneous rocks. The problems of the Middle River Group, of possible Silurian age and the age of the continental Devonian McAdam Lake Formation are discussed. Plutonic rocks range from granite to gabbro and may be of more than one age. Carboniferous rocks, mainly clastic, have a maximum thickness totaling between 25,000 and 30,000 feet. They have been divided into eight rock-stratigraphic units, which are discussed. Geologic sketch maps of the pre-Carboniferous and Carboniferous are included.—E.S.L.

8035 **Kelly, William C.; Goddard, Edwin N.** Thermometry of the telluride ores of Boulder County, Colorado [abs.]: Econ. Geology, v. 61, no. 7, p. 1301, 1966.

8140 **Kennedy, Vance C.; Brown, Thomas E.** Experiments with a sodium-ion electrode as a means of studying cation exchange rates [abs.], *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 351–352, 1966.

Kerr, Paul F. *See* Güven, Necip. 7972

Kerr, Paul F. *See* Nash, J. Thomas. 7996

7832 **Kesling, Robert V.; Strimple, Harrell L.** *Calliasterella americana*, a new starfish from the Pennsylvanian of Illinois: Jour. Paleontology, v. 40, no. 5, p. 1157–1166, illus., 1966.

Starfish from the Pennsylvanian LaSalle Limestone of Illinois are the first species of *Calliasterella* to be found outside Russia. The type and only previously known species, *C. mira*, was described in 1879 from Pennsylvanian strata near Moscow. Our specimens are much better preserved, even though in death the arms curled inward to conceal the ambulacrals and most of the adambulacrals. The madrepore is known for the first time, and the shape of the aboral side of the disk is established. Our species differs from *C. mira* in having less acuminate corners on disk plates, scattered tubercles instead of a paxillary ridge on each aboral arm plate, and differently shaped supramarginals, axillaries, and adambulacrals. Aborally, this hemizonidan starfish bears a striking similarity to the phanerozonidan *Protopalaeaster*, and many plates appear homologous.—*from* Authors' abstract

7856 **Kesling, Robert V.; Strimple, Harrell L.** Suggested growth pattern in the Mississippian (Chester) echinoid *Lepidesthes formosa* Miller: Jour. Paleontology, v. 40, no. 5, p. 1167–1177, illus., 1966.

Young plates were added to lateral columns; those which could not occupy these preferred positions passed rapidly downward meridionally and gradually shifted laterally to take their places in the eight columns typical of the species. Interambulacral plates were much wider and larger than ambulacral plates when formed, but they grew slower.—*from* Authors' abstract

8075 **Keys, David A.; Wright, Joseph Y.** Geology of the I.M.C. potash deposit, Esterhazy, Saskatchewan, *in* Symposium on salt, 2d—V. 1, Geology, geochemistry, mining: Cleveland, Ohio, Northern Ohio Geol. Soc., p. 95–101, illus., 1966.

A potash-rich zone in the Devonian Prairie Evaporite Formation near Esterhazy is being exploited by underground mining confined to the lower zone. Although flanked on the west by a zone of geosynclinal deposition and tectonic activity, the area in which evaporites were deposited was subjected to only very gentle epeirogenic activity. The sylvinite is coarsely crystalline, in well-defined beds; the halite, sylvite, and insoluble content of the ore bears a direct relation to the lithologic units, but carnallite cuts across the beds. Local concentrations of salt produce blank spots in the ore, some of which appear to be salt-filled post-ore channels and cracks, while others formed by brines emanating upward from below the ore. The present mineral assemblage does not appear to represent the original primary minerals of the deposit.—G.D.C.

8083 **Kinnear, John C., Jr.** New developments in the large scale porphyry operations of Kennecott Copper, *in* Mining Symposium, 27th Ann., and AIME, Minnesota Sec., 39th Ann. Mtg., Duluth, 1966: Minneapolis, Minn., Univ. Minnesota, Nolte Center Continuing Education, p. 75–81, illus., 1966.

In the past ten years Kennecott has mined, from its five porphyry-copper mines in the southwestern United States, 550 million tons of ore with an average grade slightly over one percent copper. Reserves are now calculated by computer and updated by combining the use of aerial photography. Research at the Western Mining Divisions encompasses new leaching techniques, recovery studies, rock structure and slope stability, and new mining and processing methods. Methods for determining optimum pit slopes are being field tested on a large scale. Included in advanced exploration techniques in areas of much overburden is the projection of geographic and geologic trends from existing mine areas, combined with geophysics and geochemistry. One successful example was finding the Safford, Ariz., orebody beneath lava flows.—G.D.C.

7890 **Kish, Leslie.** Geology of the east half of Gaboury township, Témiscamingue county [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 554, 14 p., table, geol. map, 1966.

Bedrock 20 miles east of Témiscamingue Lake is of Precambrian age. A central belt of metamorphosed lavas and pyroclastic rocks with various igneous intrusions extends roughly east-west; south of this is a belt of metasedimentary paraschists, interjected and complexly mixed with granitic and pegmatitic material; and to the north extends a large mass of gneissic granite. Age relations are only partly established; it is suggested that the central flows face south, and sedimentary rocks of the south belt are younger. Porphyritic syenite is known to intrude the gabbro and diorite; lamprophyre dikes cut only the central volcanics, but are known in other areas to be the youngest rocks of the region. Mineral occurrences include gold, copper-nickel, iron, asbestos, tungsten, and pyrite. Mining properties are described briefly.—G.D.C.

7852 **Kjellesvig-Waering, Erik N.; Leutze, Willard P.** Eurypterids from the Silurian of West Virginia: Jour. Paleontology, v. 40, no. 5, p. 1109–1122, illus., 1966.

Reclassification within the family Hughmilleriidae is proposed on the basis of morphological information gained through study of a new collection of eurypterids from the [Upper] Silurian rocks of West Virginia. Two new genera, *Pittsfordipterus* (*type species: Hughmilleria phelpsae* Ruedemann 1919, Vernon Shale of New York) and *Bassipterus* (*type species: Bassipterus virginicus* n. gen., n. sp., Wills Creek Formation of West Virginia), are proposed. *Drepanopterus nodosus n. sp.*, *Erettopterus* (*Truncatiramus*) *exopthalmus* n. sp., morphological details of

Waeringopterus cumberlandicus cumberlandicus (Swartz) and *Parahughmilleria bellistriata* (Kjellesvig-Waering) are described and illustrated. Measured sections of the Wills Mountain, Elkhorn Mountain and Hanging Rock Anticlines are included.—Authors' abstract

7957 **Klages, M. G.** Effect of clay type and exchangeable cations on aggregation and permeability of solonetz soils: Soil Sci., v. 102, no. 1, p. 46–52, illus., 1966.

Three B-horizon samples with a solodized solonetz morphology were compared with the B horizon of associated chestnut soils. The clay and montmorillonite contents were higher, and pore space was somewhat less in solonetz samples than in chestnut soils. The high exchangeable magnesium and sodium ions of the solonetz soils make them capable of increasing dispersion and decreasing permeability.—J.W.H.

Klein, Cornelis, Jr. *See* Fuchs, Louis H. 7684

8096 **Klein, Cornelis, Jr.** Mineralogy and petrology of the metamorphosed Wabush Iron Formation, southwestern Labrador: Jour. Petrology, v. 7, no. 2, p. 246–305, illus., tables, geol. map, 1966.

The metamorphic grade (kyanite-staurolite zone) of this late Precambrian part of the Labrador Trough is concluded from underlying pelitic schist assemblages. Sedimentary banding and rare relic granules are still preserved. From analyses of 34 phases of listed mineral constituents of the Wabush Iron Formation, and six of the pelitic schists, equilibrium assemblages are determined. Of the volatile components, the behavior of O_2 was inert, CO_2 variable, and H_2O perfectly mobile. In ferromagnesian silicates an increasing $Mg/(Mg+Fe)$ ratio is correlated with increase in oxidation state of assemblages, and for manganese with increasing activity of O_2. Low aluminum content in some resulted in large amounts of Na and Fe^3. The *P* and *T* conditions of metamorphism are deduced from experiments applicable to the underlying pelitic schists.—G.D.C.

Klement, K. W. *See* Toomey, D. F. 8228

8058 **Klingspor, A. M.** Cyclic deposits of potash in Saskatchewan: Bull. Canadian Petroleum Geology, v. 14, no. 2, p. 193–207, 1966.

Commercial grades of potash salts occur in three zones within the upper part of the Middle Devonian Prairie Formation of the Elk Point Group. Sylvinite is the only potash ore in the Regina sub-basin. Observations on mineral composition, texture, and clay content are interpreted to prove the primary origin of the potash ores, and hence the three zones are interpreted to represent major cycles of regression. The zones become successively less widespread upward suggesting the progressive shrinkage of the basin. The importance of widespread solution and recrystallization after burial is discounted; only the uppermost zone appears to be widely leached and contaminated by insolubles. Ores in the lowermost zone have excellent industrial qualities.—C.A.S.

8026 **Koch, George S., Jr.; Link, Richard F.** Statistical method for classification of veins and ore [abs.]: Econ. Geology, v. 61, no. 7, p. 1303, 1966.

8120 **Kodama, H.; Brydon, J. E.** Interstratified montmorillonite-mica clays from subsoils of the Prairie Provinces, western Canada, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 151–173, illus., tables, 1966.

Samples of glacial till and lacustrine soil clays selected over a distance of 900 mi across the Prairie Provinces were examined in detail by X-ray, chemical, thermal, infrared-absorption, and electron-microscope methods. There was a marked similarity among the samples. Dominant component was an 18 A phase, identified as a randomly interstratified montmorillonite-mica. Fourier transforms gave the montmorillonite content near 55 percent, whereas the chemical formula gave near 80 percent montmorillonite in the interstratified component. Small differences between samples suggested two trends differentiating the till and lacustrine samples.

The trends are probably related to K fixation during or after deposition of the lacustrine materials.—*from* Authors' abstract

7956 **Kopp, O. C.; Clark, G. W.** Synthetic pollucites in the system $Cs_2O{\cdot}Al_2O_3{\cdot}4SiO_2$–$Cs_2O{\cdot}Fe_2O_3{\cdot}4SiO_2$–$H_2O$—Their phase relationship and physical properties—A discussion [of paper by S. Kume and M. Koizumi, 1965]: Am Mineralogist, v. 51, no. 7, p. 1243–1245, 1966.

Differences in refractive index and lattice parameter for the iron end member of the above system are discussed.—E.H.R.

Kornfeld, P. *See* Alterman, Z. 8081

8182 **Kranzler, Irvin.** Origin of oil in lower member of Tyler Formation of central Montana: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2245–2259, illus., 1966.

Oil is produced from lenticular sandstone bodies in the Tyler Formation of Pennsylvanian age in central Montana. The source of this oil is believed to be petroliferous limestone strata in the underlying Heath Formation of Mississippian Age. The contact between the Tyler and the Heath is unconformable and favorable relations for oil accumulation occur where sandstone of the Tyler is in beveled contact above inclined limestone beds of the Heath as in the Sumatra, Stensvad, Ivanhoe, Keg Coulee, Bascom, Melstone, and Big Wall fields—E.K.M.

Krouse, R. *See* Folinsbee, Robert E. 8032

Kruskal, William. *See* Chayes, Felix. 8008

Kube, W. R. *See* Elder, J. L. 8093

8103 **Kuenen, Ph. H.** Experimental turbidite lamination in a circular flume: Jour. Geology, v. 74, no. 5, pt. 1, p. 523–545, illus., tables, 1966.

A circular flume, with a current driven by a horizontally revolving set of vertical paddles, was employed to demonstrate depositional structures formed by currents where processes of long duration and slow deposition are involved. The experiments described concern the origin of horizontal lamination which is common in nearly all turbidites of finer grain than coarse sand. The results show that a perfectly steady, decelerating flow, comparable to the lower part of a turbidity current, produces grading, rippling, and convolution; but it also creates lamination, providing the accumulation is not too swift. Contrary to the conclusion of some earlier workers, no current pulsation is required to form laminae. The selective concentration is due to the tendency of particles moving along the bottom to join stationary ones of equal weight, density, and shape.—*from* Author's abstract

7779 **Kugler, Hans G.** Memorial to Ralph Alexander Liddle (1896–1963): Geol. Soc. America Bull., v. 77, no. 9, p. P185–P189, portrait, 1966.

Kullerud, Gunnar. *See* Naldrett, Anthony J. 8031

Kullerud, Gunnar. *See* Brett, Robin. 8036

Kunze, G. W. *See* Gerard, C. J. 7887

Kunze, G. W. *See* Swoboda, A. R. 8112

7927 **Labarthe, Guillermo, 2d.** Cuerpo de San Pascual, mina El Encino, Pihuamo, Jal.: Geología y Metalurgía, v. 2, no. 16, p. 12–19, illus., 1966.

Principal rocks related to the San Pascual iron orebody of El Encino mine are the Cretaceous Encino Formation, intruded by monzonite porphyry, and associated with a rudistid reef facies. The deposit, which produces a magnetic anomaly, was explored by 17 diamond drill cores, and a vertical shaft is being driven. The principal mineral is magnetite (80 percent) with some hematite; gangue is mainly calcite.

The orebody is believed to have formed by replacement of the limestone in the rudistid reef facies.—E.S.L.

7847 **Lambert, T. W.** Availability of ground water in the La Center quadrangle, Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-173, scale 1:24,000, section, text, 1966.

Large undeveloped supplies of ground water are available for domestic and industrial use in the La Center quadrangle. Wells tapping Eocene sand may yield more than 500 gpm; Pliocene(?) and Pleistocene gravel will supply several hundred gpm to properly constructed wells; although several wells tap the McNairy Formation and Devonian rocks in the northern area, little is known about their yields. Water from Eocene aquifers is soft, low in dissolved solids, and slightly acidic and that from Pliocene(?) and Pleistocene gravel is moderately hard and normally has an iron content of less than 0.3 ppm; quality of water from Cretaceous and Tertiary rocks is excellent for most uses.—M.C.M.

Land, Cooper B., Jr. *See* Harris, Steven H. 8332

7942 **Land, Lynton S.** Eolian cross-bedding in the beach dune environment, Sapelo Island, Georgia, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 3 p., paged separately, illus., reprinted 1966; originally published 1964.

Slipfaces of modern beach dunes on the island are deposited by the prevailing, competent, dry winds rather than the high energy storm winds. High angle cross-bedding, with dips at least 30°, records the orientation of the prevailing winds. Approximately one half the dune slip faces and high angle cross beds are stable at angles which exceed the angle of repose of dry sand, and cross bed dips as high as 42° are stable in, and may be indicative of, the beach dune environment. Elongate sand grains are preferentially oriented parallel to the dip direction of the eolian cross-beds.—Author's abstract

Lane, H. R. *See* Rexroad, C. B. 8229

Lange, Ian M. *See* Cheney, Eric S. 8021

8188 **Langenheim, Jean H.** Botanical source of amber from Chiapas, Mexico [with Spanish summ.]: Ciencia, v. 24, nos. 5–6, p. 201–210, illus., 1966.

Contrary to the classic concept of Baltic amber, most of the Tertiary amber from Chiapas, Mexico, was not derived from pines. Among possible resin producers in the area today, the leguminous *Hymenaea* seems established as the source from concomitant evidence: the large quantity of resin produced by *H. courbaril* in coastal stream sites similar to those in which the amber was deposited; similarity of infrared spectra of the amber with resin of *H. courbaril*; and remains of *Hymenaea* in the amber. Thus new horizons are opened in the role of tropical angiosperm resin producers as a source of amber. Infrared spectroscopy is a convincing means of determining the botanical relationship. This study recognizes need to understand the resinous secretory system in various populations and the environmental provocation.—G.D.C.

8121 **Langston, R. B.; Jenne, E. A.; Pask, J. A.** Effect of impurities on the rheology of two kaolins, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 381–394, illus., tables, 1966.

Two kaolins were given five successive processing steps designed to remove nonclay and soluble fractions, organic material, iron oxides, allophane, and three-layer lattice minerals. After each step, consistency curves were obtained for each of the clays at 6.5 and 9.0 pH. The rheological behavior of kaolinite suspensions free of impurities is similar. A more quantitative analysis would require a detailed study of the structure existing in the suspension for which adequate techniques have not yet been developed.—E.S.L.

8237 **Langston, Wann, Jr.** *Limnosceloides brachycoles* (Reptilia: Captorhinomorpha), a new species from the lower Permian of New Mexico: Jour. Paleontology, v. 40, no. 3, p. 690–695, illus., 1966.

The Camp Quarry (lower Permian Cutler Formation of New Mexico) has yielded few remains of cotylosaurian reptiles. Besides a diadectomorph a species of large captorhinomorph is recognized from incomplete remains. The femur of this animal is reminiscent of *Limnoscelis paludis* in gross form, but it agrees better with *Limnosceloides dunkardensis* in several details. The species is assigned very tentatively to *Limnosceloides*, as *L. brachycoles*. Referred vertebrae are distinctive in the presence of a bridge of bone connecting prezygapophyses above the neural canal. This condition is shared with some limnoscelids recently reported from Colorado and Utah.—Author's abstract

7823 **Langway, Chester Charles, Jr.** Stratigraphic analysis of a deep ice core from Greenland [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 518B, 1966.

7826 **Laursen, Dan.** The genus *Mya* in the Arctic region [with Spanish and Russian abs.]: Malacologia, v. 3, no. 3, p. 399–418, illus., table, 1966.

The present account was written to clarify a misconception about Arctic species of *Mya*. Jensen (1900) has pointed out (in Danish) that all the then existing records of *M. arenaria* Linnaeus from the Arctic were erroneous and dealt, in fact, with a form of *M. truncata* Linnaeus which he named *ovata*. However, because Jensen's publication is not widely known in the English speaking world, *M. arenaria*, a boreal species, is still being reported from the Arctic. In this paper, the distribution, Recent and fossil, of 3 forms of *Mya truncata*, as well as that of *M. arenaria* is given, as far as it could be ascertained. The lists are not complete. Scientists working with *M. truncata* are entreated to give more details in future papers.—*from* Author's abstract

8259 **Lawson, Don E.; Smith, Jordan R.** Pennsylvanian and Permian influence on Tensleep oil accumulation, Big Horn basin, Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2197–2220, illus., 1966.

The Tensleep Sandstone of Pennsylvanian age thins northward in the Bighorn Basin indicating uplift and post–Des Moines beveling and channeling. These irregularities were filled by sediments as the Phosphoria Sea transgressed in Permian time, and the Permian strata also thin regionally northward. Oil accumulation in the Tensleep has been mostly in structurally controlled traps beneath impervious beds of the overlying Phosphoria (Park City) Formation. Accumulation in several of these traps is believed to have been favored by intraformational change in permeability or lithofacies of pervious strata against impervious channel-fillings at the base of the Phosphoria.—E.K.M.

8148 **Lazareva, A. P.** Dlinnoperiodnyye voly Releya Alyaskinskogo zemletryaseniya na Pulkovskikh seysmogrammakh: Akad. Nauk SSSR Izv. Fizika Zemli 1966, no. 7, p. 65–70, illus., tables, 1966.

Rayleigh waves with periods of 200–400 sec from the Alaska earthquake of March 1964 were observed at Pulkovo seismic station in the U.S.S.R. Experimental group velocity dispersion curves were constructed and compared with theoretical curves calculated for different Earth models. The best fit is obtained for a model with Gutenberg's velocity distribution and Bullen's Model A density distribution, in the 220–350 sec period range; the experimental points fall systematically below the theoretical curve, however.—D.B.V.

8200 **Leahy, E. J.; Wares, R.** Carman township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P.356, scale 1 in. to 1/4 mi., text, 1966.

All rocks in Carman township are Precambrian; oldest are basic and acidic volcanics which appear to be cut in turn by intrusives and diabase dikes. To the southwest strikes of flows suggest an anticlinal structure with axis trending east-west. The northwest part of the area is characterized by a series of elongate alder swamps striking N.10° W., parallel to the regional trend of glaciation and with no outcrop.

Search for gold dates back to the early 1900's and in 1964 there was renewal of interest in the area. Traces of gold and silver have been found in samples; asbestos is fairly common throughout the ultrabasic rocks; a sample of mineralized rock assayed 1.93 percent copper, 0.30 oz. silver, and 0.02 oz. gold per ton; good specimens of tremolite can be obtained in veins of ultrabasic rocks; and stichtite, containing magnesium and chromium, occurs in serpentinized dunite.—M.C.M.

8136 **Ledoux, Robert L.; White, Joe L.** Infrared studies of the hydroxyl groups in intercalated kaolinite complexes, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 289–315, illus., tables, 1966.

Attempts to correlate ν (OH) stretching frequencies of kaolinite to corresponding OH lattice sites based entirely on the ideal structural model are hazardous because the structure cannot be refined beyond the idealized arrangement. Frequency shifts were produced by selectively deuterating OH groups of expanded kaolinite according to accessibility of sites for exchange reaction. Perturbations of ν (OH) stretching frequencies were induced by promoting interaction between lattice OH groups of kaolinite and intercalated substances containing structural groups susceptible to hydrogen bonding. Therefore, correlation between ν (OH) frequencies and OH lattice sites are based on direct evidences. Infrared study suggests assignment of absorption bands 3695, 3670, and 3650 cm^{-1} to inner-surface hydroxyls and of 3620 cm^{-1} frequency to inner hydroxyls.—E.S.L.

8246 **Leopold, Luna B.; Tilson, Seymour.** The water resource: Internat. Sci. and Technology, no. 55, p. 24–34, illus., 1966.

Total water in rivers and in the ground is ample for all future needs. Regional shortages can be alleviated by proper water management and development. Whether pollution troubles can be cured at this point is in doubt. Man's intervention in natural equilibria has in effect created an entirely new hydrologic system, which man is not allowing to reach a new equilibrium. Water management studies begin to look at schemes for rerouting rivers across continents.—G.D.C.

8001 **Letowski, F.; Serkies, J.; Niemiec, J.** Application of potential pH diagrams for determination of the occurrence forms of trace elements in some economic mineral deposits: Econ. Geology, v. 61, no. 7, p. 1272–1279, illus., tables, 1966.

Mineralogical forms of trace elements in a given rock may be predicted by (1) estimating the Eh–pH conditions that prevailed in the rock from the theoretical stability fields of the major minerals present, and (2) determining the minor-element minerals that would be expected under these conditions. Moderate correspondence between theoretical and experimental phases was obtained using Eh–pH diagrams for silver, molybdenum, nickel, cobalt, vanadium, manganese, lead, and zinc as trace elements accompanying copper.—W.S.W.

Leutze, Willard P. *See* Kjellesvig-Waering, Erik N. 7852

8262 **Levorsen, A. I.** The obscure and subtle trap: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2058–2067, illus., tables, 1966.

In spite of the fact that most purely structural anomalies in the United States have been drilled for petroleum there remains much petroleum to be found in stratigraphic and combination traps, and where fluid pressure is a factor in formation of a pool. Examples of stratigraphic pools are given for Mid-Continent and Rocky Mountain areas. Testing of flanks of anticlines and synclines for combination traps is recommended even though anticlines when tested on the crests proved dry.—S.P.S.

Libby, W. F. *See* Berger, Rainer, 8250

7907 **Lichtler, W. F.; Joyner, B. F.** Availability of ground water in Orange County, Florida: Florida Board Conserv. Div. Geology Map Ser., no. 21, scale about 1 in. to 2 mi., text, 1966.

Most water for municipal, industrial, and domestic use and much irrigation water in Orange County is obtained from the highly productive Floridan aquifer which is composed here of more than 1,300 feet of dense to extremely porous limestone and dolomitic limestone. Yields of 4,000 gpm or more can be obtained from properly designed wells in almost any part of the county. In the western part, most water is relatively low in mineral content; to the east, fresh water is underlain at depth by salty water; in the extreme eastern part the water is so highly mineralized that it is unfit for most purposes. Illustrations and inset maps show availability of ground water, quality of water that can be expected, and approximate depth and length of casing required in wells.—M.C.M.

7916 **Lindsey, Alton A.** (editor). Natural features of Indiana—Symposium, Wabash College, 1966 (Indiana Sesquicentennial Volume, 1816–1966): Indianapolis, Ind., Indiana Acad. Sci., 600 p., illus., tables, 1966.

In this symposium papers by individual authors on bedrock geology, glaciation, physiography, soils, lakes and streams, ground water, caves, and mineral resources, are cited separately. Other papers on living resources, cultural history, changing patterns in agriculture and population, and state parks, deal briefly with ecology, but are not cited.—G.D.C.

Link, Richard F. *See* Koch, George S., Jr. 8026

8161 **Lipps, Jere H.** Wall structure, systematics, and phylogeny studies of Cenozoic planktonic Foraminifera: Jour. Paleontology, v. 40, no. 6, p. 1257–1274, illus., tables, 1966.

Three types of wall microstructure were found: walls of identical, nearly parallel calcite crystals perpendicular to test surface; walls of short, prominent crystals surrounded within the wall by finer crystals; and walls in which some crystals are elongated as spines and surrounded within the wall by finer crystals. These microstructures and the basic type of chamber coiling are utilized for recognition of four families: Globorotaliidae, with eleven genera in two subfamilies (Globorotaliinae and Candeininae), have trochoid tests whose walls consist of identical crystals; Hantkeninidae, with five genera in two subfamilies, are initially planispiral, and their walls have identical crystals; Catapsydracidae, with four genera, have walls of short, prominent crystals; and Globigerinidae, with thirteen genera, have walls in which some crystals are elongated into spines.—*from* Author's abstract

7897 **Loewe, F.** Das Inlandeis Grönlands: Umschau, v. 66, no. 16, p. 532–538, illus., 1966.

Knowledge of the Greenland Ice Cap has increased extraordinarily in the last 20 years, due to better transportation possibilities, new research methods and instruments, and the strategic and commercial importance of that hitherto unimportant region. Results of studies of the altitude of the ice surface, the climate, and the thickness, mass budget, movement, and temperatures of the Ice Cap are reviewed.—D.B.V.

Long, James A. *See* Dobrin, Milton B. 8151

8094 **Loomis, A. A.** Contact metamorphic reactions and processes in the Mt. Tallac roof remnant, Sierra Nevada, California: Jour. Petrology, v. 7, no. 2, p. 221–245, illus., tables, 1966.

In a large roof remnant within the composite Sierra Nevada batholith, contact metamorphic facies vary from actinolite hornfels to pyroxene hornfels; the latter facies occur only where two aureoles overlap; hornblende hornfels facies surround most plutons. The rate of reaction in the pyroxene-hornfels facies was controlled by the rate of escape of water. The reaction of epidote to andradite took place in the high-grade facies. The highest crystallization temperature within the hypersthene rocks is estimated to have been 750°C; recrystallization of clinopyroxene-bearing mafic hornfels, 625°C to 650°C, and of hornblende-bearing mafic hornfels, 525°C to 550°C. Fabric of the hypersthene rocks suggests heat transfer to walls mostly by conduction and radiation. Hot magmatic vapor produced

a retrograde zone at the end of the recrystallization period; the high-temperature phase endured an estimated 10^5 years.—G.D.C.

Lovborg, Leif. *See* Hansen, John. 8146

Luft, Stanley J. *See* Colton, George W. 7909

8073 **Lundy, B. R.; Gordon, D. C.; Robinson, J. L.** Evidence of Winnipegosis reef build-up from reflection seismic data [abs.]: Oilweek, v. 17, no. 30, p. 36, 1966.

7801 **MacGowan, Roger A.; Ordway, Frederick I., 3d.** The origin and development of life, Chap. 5; Biological evolution, Chap. 6, *in* Intelligence in the universe: Englewood Cliffs, N. J., Prentice-Hall, p. 88–158, illus., table, 1966.

Life is defined by 10 attributes common to all. The role of catalysis and auto-catalysis are diagrammed, and cellular and multicellular life discussed. Environmental conditions in the pre-fossil stage of the Earth included a warmer Earth and different atmosphere; as life evolved, oxygen in the atmosphere increased, and the ozone screen formed. Paleogeography and evolution through the Paleozoic are reviewed. Development of reptiles in the Triassic and transition to mammals was perhaps due to arid climate; in Jurassic, dinosaurs reached their peak, and the Cenozoic saw the rise of mammals and the emergence of *Homo*; species of the latter are described. Trends in evolution, and evolution on extrasolar worlds are discussed.—E.S.L.

8044 **MacNeill, R. H.; Take, W. F.** Triassic basalt and structure, Nova Scotia [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 67–70, illus., 1966.

The Triassic North Mountain Basalt consists of a number of tholeiitic flows and flow units, the lowest of which generally exhibits columnar jointing. The dip of the flows closely corresponds to that of the underlying sediments, from 6 to 10 degrees toward the southwesterly plunging axis of the Minas syncline. Some minor flexing and faulting is evident in the area. Younger flows and flow units of the basalt are more zeolitic.—*from* Authors' abstract

8047 **MacNeill, R. H.; Hope-Simpson, D.** Stratigraphy of western Nova Scotia [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 89–94, illus., table, 1966.

Much of western Nova Scotia is underlain by metamorphosed Cambrian-Ordovician strata (Meguma Group), flanked on the northwest by Silurian and Lower Devonian sediments and volcanic rocks. All these rocks were deformed, metamorphosed, and intruded by granite batholiths before the Lower Mississippian Horton Group was deposited. Post-orogenic, chiefly continental Mississippian, Pennsylvanian, and Triassic sediments and Triassic basalt lie unconformably upon older rocks.—Authors' abstract

8049 **Magnet Cove Barium Corporation.** Walton mine, Nova Scotia [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 107–112, illus., tables, 1966.

The Walton quarry and mine has produced barite since 1941 and base metal sulphide concentrates since 1961. The main sulphide orebody occurs at the southeast end of the barite orebody. Both have replaced a probable block of massive and brecciated limestone in the central part of a large drag-fold. The limestone is part of the Pembroke Formation, one of the lower units of the marine Upper Mississippian Windsor Group.—Author's abstract

8092 **Mallory, W. W.** Cattle Creek anticline, a salt diapir near Glenwood Springs, Colorado: Mtn. Geologist, v. 3, no. 4, p. 181–184, illus., 1966.

The Cattle Creek anticline, 7 miles south of Glenwood Springs, Garfield County, Colo., is determined by vertical dip in gypsum of the Eagle Valley Evaporite on the west side of the Roaring Fork Valley and by gentle dip of the Maroon Formation on the east side. A well 3,060 feet deep near the axis of the structure penetrates a thick section of gypsum, anhydrite, and halite probably older than the beds exposed at the surface. Presence of an isolated arch of halite only 2,100 feet below the surface in a strongly expressed anticline indicates diapiric structure. Potash and oil or gas may be present at depth.—Author's abstract

7906 **Malloy, R. J.; Harbison, R. N.** Marine geology of the northeastern Gulf of Maine: U.S. Coast and Geod. Survey Tech. Bull. 28, 15 p., illus., 1966.

A combined hydrographic, seismic, and magnetic survey was made in 1962 near the mouth of the Bay of Fundy. The resulting bathymetric map, bedrock morphology map, isopach map of the sediments, and total field magnetic map are presented (in pocket). The bedrock map reveals a morphological grain controlled by northeast striking geological structure, not by glacial erosion. Folds, cuesta ridges, faults, and dikes, corroborated by magnetic anomalies, contribute to this trend; the area is assigned to the Appalachian physiographic province. One large ring dike is weakly reflected. Maine's rectilinear shore and parallel submarine scarps also support faulting (D. W. Johnson, 1925). Bedrock relief buried beneath recent sediments, appearing as shoals to the hydrographer, were revealed by seismic reflection as continuous ridges. The geologic history of the Gulf of Maine is summarized.—G.D.C.

8063 **Margolis, Stanley.** Electron micrography of modern and ancient quartz sand grains: Coastal Research Notes, v. 2, no. 2, p. 7–8, 1966.

Features found on quartz sand grain surfaces that give an indication of whether the sand has been subject to glacial, eolian, mechanical marine, or chemical processes are described. Surfaces of quartz grains from 22 samples associated with the Georgia kaolin deposits were examined with an electron microscope; the vast majority indicated either a vigorous stream or marine environment. Chemical triangles were more abundant than mechanical in the hard kaolin deposits, indicating marine deposition. Soft clay sand grains have features similar to those from modern beaches, and may have been deposited with feldspar and other minerals, which later altered to kaolinite. Source of the clay balls in the crossbedded sands may have been the soft clay deposits. Grains from the kaolin deposits also show signs of ground-water solution.—E.S.L.

Marques, J. M. *See* Sumner, M. E. 7845

Marranzino, A. P. *See* Erickson, R. L. 8189

8183 **Martin, Rudolf.** Paleogeomorphology and its application to exploration for oil and gas (with examples from western Canada): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2277–2311, illus., 1966.

Hydrocarbons may be trapped as a result of paleogeomorphological process. The traps may occur below or above (against) the morphological surface. The most important stratigraphic levels at which buried landscapes occur are those that formed after major periods of orogenesis. Their geographical locus corresponds to the broad belts of subsequent transgressions.—A.E.R.

Marvin, Ursula B. *See* Dodd, Robert T., Jr. 7976

7881 **Mathieu, Arthur.** Geology of the northeast quarter of Roy township, Abitibi-East county [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 553, 20 p., table, geol. map, 1966.

This area north of Chibougamau Lake lies within the Superior Province near the east end of a "greenstone" belt truncated by Grenville gneisses. All the rocks are in one of three Precambrian formations: the Lac Waconichi comprises a thick series of tuffs, overlain by pillowed andesite and basalt of the Lac Gilman, then felsic pyroclastic rocks and mafic lavas of the Lac Blondeau. A dike of quartz and feldspar

porphyry appears to be the youngest intrusive; except for this dike, all rocks were folded in the Kenoran orogeny into a major isoclinal syncline trending easterly, with a plunge of a few degrees north of Rapides Bay, where a remnant of the Chibougamau Series rests unconformably. The whole area is traversed by the northeasterly extension of the McKenzie Narrows fault. The presence of sulfide minerals and asbestos warrants further exploration.—G.D.C.

Mathieu, Arthur. *See* Duquette, Gilles. 7924

Mayer, Wallace M. *See* Tackett, Stanford L. 8224

7812 **McAlester, A. Lee.** Evolutionary and systematic implications of a transitional Ordovician lucinoid bivalve [with Spanish and Russian abs.]: Malacologia, v. 3, no. 3, p. 433–439, illus., 1966.

Stratigraphic and morphologic evidence indicate that the rare Ordovician bivalve *Babinka* is an evolutionary transition between the bivalve superfamily Lucinacea and some monoplacophora-like ancestral mollusc. Paleontologic evidence and comparative functional studies of recent forms suggest that the Lucinacea, Leptonacea and *Babinka* represent an independent evolutionary lineage which has maintained unique adaptive features since early Paleozoic time. This lineage should probably be treated as a separate bivalve taxon of the highest rank. Lucinoids do not appear to have given rise to other major groups of bivalves and are probably unrelated to most other "heterodont" forms with which they are commonly associated. The independent origin of lucinoid bivalves suggests that the Bivalvia had a polyphyletic origin from non-bivalved ancestral molluscs.—Author's abstract

8108 **McCaleb, Stanley B.** X-ray diffraction automation and its use in clay mineralogy, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 123–130, illus., 1966.

The standard Philips X-ray diffraction equipment has been fully automated for continuous unmonitored operation. Simultaneous readout on the Brown Recorder strip chart and magnetic tape provide records for visual and computer processing. Computer programs have been developed for processing the digital output that is in the form of cumulative pulse counts for angular position and intensity of the reflection. These data are converted to *hkl* spacings in angstroms and intensities after removal of background count. A program has been developed that identifies the minerals and prints out the spacings and intensities used for identification. Solvation and heat treatment data are utilized to aid in identification of clay minerals. Selected data from sediments are used to illustrate the output of the automated instrument and the increased resolution and speed of the equipment.—*from* Author's abstract

8011 **McCammon, Richard B.** Principal component analysis and its application in large-scale correlation studies: Jour. Geology, v. 74, no. 5, pt. 2, p. 721–733, illus., tables, 1966.

Principal component analysis is an effective means for reducing the number of variables in large-scale correlation studies of data where the variables exhibit significant linear correlation. Linear combinations of the variables, called "principal components" are extracted successively and component scores are used to replace the original variables. The scores characterize each sample and may be used in subsequent classification or correlation analysis. Reduction of the principal components to a simple structure is achieved by means of a new method of minimum entropy rotation.—A.T.M.

McCarthy, J. Howard, Jr. *See* Gott, Garland B. 7965

7986 **McCulloch, David; Hopkins, David.** Evidence for an early Recent warm interval in northwestern Alaska: Geol. Soc. America Bull., v. 77, no. 10, p. 1089–1107, illus., table, 1966.

A warm interval beginning at least 10,000 yr b.p., when climates in other parts of the world became nonglacial, and lasting until at least 8300 yr b.p., is recorded in coastal tundra-covered northwestern Alaska by eight radiocarbon dates associated with fossil wood of tree size or tree species, fossil beaver-gnawed wood beyond modern beaver range, evidence of ice-wedge melting, buried soils, and soils below modern permafrost table. The warm interval preceded, and may have been separated by, a brief cooling period from the northern Alaskan "thermal maximum" (6000–3000 yr b.p.) known from dated pollen profiles and glacial recession. The "thermal maximum" was not well developed on the coast, probably because summer temperatures were depressed as rising post-glacial sea level made the climate maritime.—Authors' abstract

7782 **McDougal, Robert B.** The mineral industry of Oklahoma in 1965 (advance summary of final figures): Oklahoma Geology Notes, v. 26, no. 9, p. 227–230, table, 1966.

8042 **McFarlane, P.; Gates, W. J.** Geology of the Heath Steele sulphide deposits [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 59–62, illus., 1966.

The sulfide deposits of Heath Steele Mines Limited in New Brunswick occur in minor folds on the northern limb of a large northwesterly plunging, complex anticline involving the Ordovician Tetagouche Group. They occur near the contact between quartz-feldspar augen schist, and a mixed assemblage of schists, iron formation, and feldspathic rocks. Twelve sulfide bodies, grouped into five zones, occur in a belt about 5.5 mi long. Pyrite-sphalerite-galena is the main sulfide mineral assemblage in most orebodies. Many of the bodies exhibit varying degrees of oxidation and supergene enrichment.—E.S.L.

8210 **McGavock, E. H.; Edmonds, R. J.; Gillespie, E. L.; Halpenny, P. C.** Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Pt. 1A, Supplemental records of ground-water supplies: Arizona Land Dept. Water Resources Rept. 12-E, 55 p., illus., tables, 1966.

This supplement to Report 12-A, by G. E. Davis and others (1963) which covered data through 1956, is a field inventory of wells and springs in the Navajo and Hopi Indian Reservations, completed in 1961. The comprehensive report on the ground-water resources and geology of the reservations will be published in separate chapters in U.S. Geological Survey Professional Paper 521.—M.C.M.

7846 **McGovern, Harold E.; Jenkins, Edward D.** Ground water in Black Squirrel Creek valley, El Paso County, Colorado: U.S. Geol. Survey Hydrol. Inv. Atlas HA-236, scale about 1 in. to 1 mi., text, 1966.

Alluvium in the Black Squirrel Creek valley, chiefly Pleistocene clay, silt, sand, and gravel, is underlain by a thick sequence of Upper Cretaceous to Paleocene shale, sandstone, and arkosic conglomerate, which dips northward into a large structural basin. The alluvial aquifer is recharged by infiltration of surface runoff, by underflow in channels, and from precipitation. The aquifer is discharged by underflow out of the valley, by pumping, by infiltration into underlying bedrock formations, and by evapotranspiration. The water is moderately hard, but suitable for most uses. Ground water may be pumped for short periods at a rate exceeding the underflow without seriously depleting the aquifer.—M.C.M.

McGrain, Preston. *See* Keller, W. D. 8134

McGregor, Alexander A. *See* Bolyard, Dudley W. 8266

7901 **McGrew, Wesley C.; Haarr, Allan P.** (editors). Speleo digest 1964—A collection of speleological writings taken from the publications of the Chapters of the National Speleological Society: Vienna, Va., The Speleo Digest, [410] p., illus., 1966.

The volume is divided into four sections, and has author and subject indexes. The first section, 172 pages, contains cave descriptions, grouped by state. Cave science

comprises the 82 pages of the second section, including cave features, genesis, age, types, mineralogy, biota, and history. The third section, 121 pages, contains articles on technique and equipment. The last section is devoted to humor.—E.S.L.

McKeever, John H. *See* Harris, Steven H. 8332

8212 **Medina Rivero, Flavio.** Aguas subterráneas en una misma formación calcárea: Geología y Metalurgía, v. 2, no. 15, p. 36–40, illus., 1966.

Graphic representations of analyses of water samples extracted in different areas of the same calcareous formation are compared. All graphs in the semilogarithmic diagrams presented are related in their turn with noted points in the triangle of Villalobos. The Cárdenas Formation of Late Cretaceous (Maestrichtian) age is very compact in its layers, only the fissile shales able to store little water and retain it long. Ground water was found in low dry arroyos of San Luis Potosí, near San Nicholás Tolentino and Ciudad del Maíz. The phreatic level is not very deep; the water exhibits the calcomagnesian character of the aquifer; in outcrop it should be cold and very close to the surface.—G.D.C.

7891 **Medina Romero, Flavio.** Estudio geohidrológico de la región Cerritos–Villa Juárez, S.L.P.: Geología y Metalurgía, v. 2, no. 16, p. 38–61, illus., tables, 1966.

The hydrogeologic study was done to determine the volume and quality of ground water reaching the surface in this western part of the Rioverde Plains. In the surrounding mountains karst topography and deep canyons are common. Cretaceous sedimentary rocks, and rhyolite and basalt extrusive rocks form the bedrock. Many springs occur, and 20 of the 134 water samples were taken from them; 108 were from wells, all but 10 of which were in alluvium. Temperature of ground water ranges from 16°C to 30.8°C, with the greatest range in springs. Underground drainage comes primarily from the Villar–Montana canyon on the northwest, and El Tablón and adjacent mountains on the south. Chemical analyses of the water are interpreted and tabulated.—E.S.L.

Meents, W. F. *See* Graf, D. L. 8218

8240 **Megrue, G. H.** Rare-gas chronology of calcium-rich achondrites: Jour. Geophys. Research, v. 71, no. 16, p. 4021–4027, illus., tables, 1966.

The isotopes of He, Ne, and Ar from pyroxene and feldspar concentrates of 1 mesosiderite and 4 achondrites were analyzed. Concordant K–Ar ages indicate that diffusion of radiogenic Ar after crystallization has been negligible. If the initial time of differentiation was 4.5 b.y. ago, these meteorites either represent surface material of a large parent body or are derived from the interior of a body of <200 km radius. The thermal history is difficult to interpret because the location of U and the amount of radiogenic He-4 removed with recent diffusion of He-3 are unknown. Exposure ages determined on pyroxenes appear to be more accurate than those calculated from the rare gas content of the meteorite as a whole.—D.B.V.

8076 **Merrill, William M.** (and others). Recommendations—Academic preparation of secondary school earth science teachers: Jour. Geol. Education, v. 14, no. 1, p. 29–32, 1966.

This is a report of the Council on Education in the Geological Sciences Panel meetings since its organization in 1964. Charged to work with the Earth Science Curriculum Project, and also maintain close liason with other organizations interested in earth science, the Panel defined its mission to include program and recruitment. Only the pre-service curricula is discussed herein. Among the recommendations, competence in a foreign language is desirable, and the curriculum should include methods of teaching and practice teaching in earth science, one year each of related sciences as early as possible, and mathematics. Duplication in both physical geology and physical geography should be avoided. The earth science major should permit a student to specialize; basic courses for four or five years, and appropriate electives are recommended.—G.D.C.

7789 **Merritt, C. A.** Rim albite in coarse-grained Quanah Granite, Wichita Mountains, Oklahoma: Oklahoma Geology Notes, v. 26, no. 8, p. 211–213, illus., table, 1966.

In the coarse crystalline phase of the Quanah Granite of the Wichita Mts., albite occurring as partial rims on perthite is common. The granite is an alkaline leucogranite with hypidiomorphic granular texture. A chemical analysis indicates high sodium and low calcium contents. The albite rims are narrow (rarely exceeding 0.02 mm in width) and normally are present on only one or two sides of the host feldspar. The rims are best explained as albite exsolved from potassium feldspar on cooling. The large feldspar crystals indicate good crystallization conditions even though the pluton was emplaced at shallow depths. The coarse texture and shallow emplacement suggest that the magma had appreciable volatile content and cooled to a low temperature before it completely crystallized. Such an environment would favor extensive exsolution of albite.—B.S.H.

8335 **Meyboom, Peter.** Groundwater studies in the Assiniboine River drainage basin—Pt. 1, The evaluation of a flow system in south-central Saskatchewan [with French abs.]: Canada Geol. Survey Bull. 139, 65 p., illus., tables, 1966.

Discernible ground-water phenomena of a typical prairie drainage basin have been related to a flow system in a geological model, called the Prairie Profile. This model consists of a central topographic high bounded at either side by an area of lower elevation. Geologically, the profile is made up of two layers of different permeability, the upper layer having the lower permeability. The ground-water flow is vertical in the poorly permeable layer and lateral in the underlying permeable layer. Through the profile is a steady flow of ground water from the area of recharge to the area of discharge. The distribution of recharge and discharge areas can be mapped by ground-water outcrops. A ground-water outcrop is defined as any area where ground water emerges at the surface. Mapping the flow system is a prerequisite to an intelligent evaluation of the ground-water balance of a drainage basin.—*from* Author's abstract

Meyer, F. W. *See* Pride, R. W. 7804

8043 **Meyer, K. V. S.** Geology of the Wedge mine [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 63–65, illus., 1966.

The orebody occurs in the Tetagouche Group in a reverse drag-fold on the south limb of a plunging syncline, 25 mi southwest of Bathurst, New Brunswick. It consists of 95 to 100 percent sulfides with 3 percent Cu and 1.75 percent Zn. Pyrite is the main mineral, and Cu ore occurs within the coarser-grained pyrite. A cross section is included.—E.S.L.

8007 **Miesch, A. T.; Chao, E. C.-T.; Cuttitta, Frank.** Multivariate analysis of geochemical data on tektites: Jour. Geology, v. 74, no. 5, pt. 2, p. 673–691, illus., tables, 1966.

Information pertaining to the parent material from which tektites were derived and to the processes which led to their formation is contained in estimates of the correlations among tektite compositional variables. The correlations, however, are affected by the fact that the compositional variables have a constant sum; the total covariance for any major or minor constituent is determined entirely by its variance. As an alternative to studying the percentage data, correlations among ratios of each constituent to SiO_2 are examined for 21 Texas tektites by means of factor analysis, and a tentative model is derived to account for about three-fourths of the covariance in the data.—A.T.M.

Miller, B. B. *See* Berry, E. G. 7813

7784 **Miller, Barry B.** Five Illinoian molluscan faunas from the southern Great Plains [with Spanish and Russian abs.]: Malacologia, v. 4, no. 1, p. 173–260, illus., tables, 1966.

The mollusks from five Illinoian assemblages in northwestern Oklahoma and Meade County, Kansas—the Berends, Doby Springs, Adams, Butler Spring, and Mount Scott local faunas—are listed. Five species are new to the southern Plains. A summary of information consisting of geologic range, distribution and ecology is given for all of the mollusks in the Mount Scott and Doby Springs faunas, and for previously unreported species from the others. Local stratigraphy (Pliocene and Recent), measured sections, and a geologic map, for the Big Springs Ranch area are given. Taxonomic changes include assignment of *Promenetus exacuous* and *P. kansasensis* to a single species complex, under the first name.—*from* Author's abstract

7822 **Miller, Charles Nash, Jr.** The evolution of the fern family Osmundaceae [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 375B–376B, 1966.

Miller, Richard H. *See* Barnes, Virgil E. 8252

8000 **Mills, Joseph W.; Eyrich, Henry T.** The role of unconformities in the localization of epigenetic mineral deposits in the United States and Canada: Econ. Geology, v. 61, no. 7, p. 1232–1257, illus., tables, 1966.

Unconformities are important in localizing epigenetic ore deposits in at least 68 districts. These deposits represent a wide range of mineral commodities, as well as structural and genetic types. "The principal role of the unconformity has been to provide, directly or indirectly, porous and permeable plumbing systems for the circulation of ore-forming fluids or for the deposition of valuable epigenetic mineral deposits." Six categories of control by unconformities are recognized.—W.S.W.

8194 **Mills, Willard B.** Base-flow studies, Big Elkhart and Little Elkhart Creeks, Trinity River basin, Texas—Quantity and quality, September 15–16, 1965: Texas Water Devel. Board Rept. 26, 17 p., illus., tables, 1966.

Big and Little Elkhart Creeks flow across outcrops of the Tertiary Sparta Sand, Weches Greensand, and Queen City Sand. The Sparta is the principal source of ground water in Houston County, and yields the largest amounts of base flow. No large gain or loss of base flow was indicated in either channel. A proposed reservoir on Little Elkhart Creek will overlie the relatively impermeable Weches Greensand, and should be fairly tight. Chemical analyses, shown in tables and graphs, indicate that water in both creeks can be used for all purposes.—E.S.L.

7911 **Milne, V. G.** Cirrus Lake sheet, Thunder Bay District: Ontario Dept. Mines Map 2098, scale 1:31,680, 1966.

7912 **Milne, V. G.** Bamoos Lake sheet, Thunder Bay District: Ontario Dept. Mines Map 2099, scale 1:31,680, 1966.

Mineralogical Association of Canada. *See* Geological Association of Canada. 8330

8211 **Minnesota Division of Waters.** The Lake Superior watershed unit: Minnesota Div. Waters Bull. 24 (Hydrol. Atlas Minnesota Ser. Unit 2), 61 p., illus., tables, 1966.

This unit comprises the watersheds of all streams entering Lake Superior from Minnesota (except the St. Louis River) and includes a portion of the Nemadji River basin. Dominant landforms reflect glacial erosion, average thickness of glacial sediments is probably less than 50 feet, and controlling boundaries are the highland and Nickerson moraines. Stages of three large glacial lakes filling the present basin are discernible in several places. Bedrock consists mainly of late Precambrian lava flows, gabbro and diabase. In Cook County economically important minerals are associated with the Rove Slate, and the Duluth Gabbro has possibilities. Ground water is available from alluvial sands and gravels along valleys, and from glacial sediments; regional occurrence is outlined on a series of maps. Artesian conditions may occur where dikes cut dipping lava flows. Analyses of water are tabulated.—E.S.L.

Montgomery, J. H. *See* Smith, J. T. 8258

Moodie, C. D. *See* Smith, H. W. 7888

Moore, Carleton B. *See* Tackett, Stanford L. 8224

7913 **Moore, J. C. G.** Holmes–Burt area, Timiskaming District: Ontario Dept. Mines Map 2078, scale 1:31,680, 1966.

8153 **Morris, R. W.; Kay, Marshall.** Ordovician graptolites from the Middle Table Head Formation at Black Cove, near Port Au Port, Newfoundland: Jour. Paleontology, v. 40, no. 5, p. 1223–1229, illus., 1966.

The graptolites include 13 genera and 18 species which seem to represent lower Llanvirnian age and have been assigned to the Whiterock Stage. About 1300 specimens were collected in five collections. Half the species occur as less than 2.5 percent of the total fauna of each collection. Therefore, a collection from a given locality may lack some of the rarer species. Each of the five collections was found to lack one to five species of the known fauna.—R.C.D.

7877 **Morrison, Roger B.** Predecessors of Great Salt Lake, *in* The Great Salt Lake: Utah Geol. Soc. Guidebook to Geology of Utah, no. 20, p. 77–104, illus., 1966.

Lacustrine strata, common in middle and late Tertiary formations of Utah, are spotty and so faulted that records of the lakes are exceedingly vague. Evidence is not of marked fluctuation due to climatic changes, but of probable disruption of drainage from faulting, warping, and intermittent volcanism. Much deeper, pluvial lakes are indicated for Quaternary time; two of Kansan and Illinoian age had at least two lake cycles. Probably at least 10 sizable lake cycles during the past 70,000 to 100,000 years are collectively known as Lake Bonneville, whose shorelines are conspicuous features of Utah landscape. The lake history recorded in the exposed stratigraphic succession in the Lake Bonneville area is interpreted in summary form, and correlated with Rocky Mountain and Midwest glaciation. Recessional intervals were generally dessicating.—G.D.C.

Mortland, M. M. *See* Cloos, P. 8125

8118 **Mossler, John H.; Hayes, John B.** Ordovician K–bentonites of Iowa [abs.], *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 141, 1966.

Mueller, Robert F. *See* Olsen, Edward, 8101

8095 **Muir, I. D.; Tilley, C. E.; Scoon, J. H.** Basalts from the northern part of the Mid–Atlantic Ridge—[Pt. 2], The *Atlantis* collections near 30° N: Jour. Petrology, v. 7, no. 2, p. 193–201, illus., tables, 1966.

The basalts of the Mid–Atlantic Ridge dredged by the *Atlantis* (1947) Expedition at latitudes near 30° N. may be distinguished as a group from the previously described *Discovery II* (1960) suite obtained from positions along the Ridge near 45° N. (Muir and Tilley, 1964). In particular the *Atlantis* collections are theolitic in character, and have much lower potash values; high alumina type basalts are unrepresented amongst them. The closest chemical approach among oceanic island basalts are the primitive Pololu Series of Kohala Mt., Hawaii (Macdonald and Katsura, 1964).—Authors' abstract

8175 **Murphy, James L.** The Pennsylvanian nautiloid *Kionoceras ungeri* (Sturgeon and Miller): Jour. Paleontology, v. 40, no. 6, p. 1388–1390, illus., 1966.

New material from the Vanport and Putnam Hill Members of the Allegheny Group in eastern Ohio and western Pennsylvania indicates that the monotypic genus *Ungeroceras* originally described from a shaly facies of the Putnam Hill Limestone is a junior synonym of *Kionoceras* Hyatt.—R.E.G.

Myers, B. N. *See* Broom, M. E. 8195

7821 **Myers, Ralph Lawrence, 2d.** Biostratigraphy of the Cardenas Formation, (Upper Cretaceous) San Luis Potosí, Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 519B–520B, 1966.

8031 **Naldrett, Anthony J.; Craig, J. R.; Kullerud, Gunnar.** Pentlandite exsolution in iron–nickel sulfide ores [abs.]: Econ. Geology, v. 61, no. 7, p. 1307, 1966.

7996 **Nash, J. Thomas; Kerr, Paul F.** Geologic limitations on the age of uranium deposits in the Jackpile Sandstone, New Mexico: Econ. Geology, v. 61, no. 7, p. 1283–1287, illus., table, 1966.

Uranium ore and associated sedimentary structures are truncated by an erosional surface under reworked sandstone beneath the Cretaceous Dakota Sandstone. Much of the uranium thus appears to have been introduced shortly after deposition of the host sediment.—W.S.W.

7978 **Naumann, A. W.; Dresher, W. H.** The influence of sample texture on chrysotile dehydroxylation: Am. Mineralogist, v. 51, no. 7, p. 1200–1211, illus., table, 1966.

Sample texture has a pronounced influence on chrysotile dehydroxylation at high temperatures. Specimens of high surface area dehydroxylate to form an *x*-ray-amorphous phase that remains stable for at least 150°C, after the dehydroxylation has taken place. As temperature is increased further, forsterite forms rapidly over a very narrow temperature interval. With specimens of low surface area, both the dehydroxylation and the forsterite formation occur more gradually and there is little or no indication of an amorphous region. These observations are interpreted to indicate that the dehydroxylation of chrysotile is governed by the ease with which molecular water can be removed from reaction sites. The data presented indicate that the rate of water removal is a function of the surface area of the unheated specimen.—*from* Authors' abstract

8029 **Neathery, Thornton L.; Deininger, Robert W.** Physical conditions of mineralization and metamorphism, Cragford, Alabama [abs.]: Econ. Geology, v. 61, no. 7, p. 1306, 1966.

8177 **Neidell, Norman S.** Discussion of "The use of linear programming to filter digitized map data," by E. L. Dougherty and S. T. Smith [1966]: Geophysics, v. 31, no. 4, p. 828–829, 1966.

Dougherty and Smith (ibid., v. 31, no. 1, p. 253–259, 1966) showed how Taylor's theory can be used to justify a local polynomial fit, but did not make clear that the same justification is also valid for the least squares method. Essentially they chose an approximation in the "L_1" Norm instead of the "L_2" or Least Squares Norm. The superiority of any norm depends on the distribution of residuals; in some cases the $L_{infinity}$ (Min–Max) Norm would be best.—D.B.V.

7964 **Neiheisel, James.** Heavy minerals in coastal Georgia sediments, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, p. 64–66, 1966.

The less-stable heavy minerals have been leached from the older Pleistocene terraces and Coastal Plain formations of Georgia, but the continental shelf, beach, and barrier islands still contain the full suite. Thick seams of black sand in the upper-beach area are natural concentrates effected by littoral currents. Thin lamina of heavy minerals in dunes are concentrated by eolian agencies. Heavy mineral studies are especially useful for determining source materials.—E.S.L.

7898 **Nevo, Z.; Hagin, J.** Changes occurring in soil samples during air-dry storage: Soil Sci., v. 102, no. 3, p. 157–160, illus., 1966.

Both sterile and nonsterile soil samples show that the processes that occur during dry storage are independent of microflora. The detection of changes in a nitrogen

atmosphere indicates that the process is not a purely chemical oxidation. It seems that the major factor involved is a change in the physical structure of the organic fraction. A good correlation was obtained between the nitrification rate and the surface area of the particles of the soil.—J.W.H.

7903 **Newell, Norman D.** Problems of geochronology: Acad. Nat. Sci. Philadelphia Proc., v. 118, no. 3, p. 63–89, illus., 1966.

The international geologic time scale is based on a continuing and evolving synthesis of world stratigraphy and paleontology. It provides a convenient division of Earth history into chapters founded on outstanding physical and biological episodes, especially mass extinctions. The abrupt faunal changes within and at the boundaries of the Mesozoic are analyzed. Earth events may be given relative dates by fossils and absolute dates by isotopes. On the other hand, Earth history may be classified by rock character, fossils, and stratigraphic sequence. Classification and chronology do not necessarily coincide precisely. Rates of deposition of carbonate sediments suggest that sedimentary gaps represent at least 50 and probably more than 90 percent of Phanerozoic time.—E.S.L.

Nichparenko, S. *See* Wilson, C. R., 7937

8174 **Nicol, David.** Cope's Rule and Precambrian and Cambrian invertebrates: Jour. Paleontology, v. 40, no. 6, p. 1397–1399, 1966.

The phyletic trend toward increase in size of invertebrates (Cope's Rule) is invoked to account for the sudden appearance of shelly forms in the Cambrian. Earlier forms may have been too small and poorly organized to secrete shells.—R.E.G.

7994 **Nielsen, Richard L.** Origin of primary textural and mineralogic zoning in a copper-bearing quartz monzonite stock, Santa Rita, New Mexico [abs.]: Econ. Geology, v. 61, no. 7, p. 1295, 1966.

Niemiec, J. *See* Letowski, F. 8001

8160 **Nitecki, M. H.; Rigby, J. K.** *Vintonia doris* a new Mississippian demosponge from Arkansas: Jour. Paleontology, v. 40, no. 6, p. 1373–1378, illus., 1966.

Two exceptionally well-preserved specimens of *Vintonia doris*, a new demosponge, are found in concretions within the Mississippian Fayetteville Shale in northern Arkansas in an association which suggests that the sponges were part of the diet of cephalopods. The species is a slightly nodose form that has a deep, broad open spongocoel and a large osculum. Relatively thin walls of the sponge are clearly separable into an organic-rich ectosomal layer and a more open vesicular choanosomal layer. Depressions in the choanosome, opening into the spongocoel, are interpreted as flagellate chambers. Two buds(?) are present in one section of the type specimen. *Vintonia* is placed in a new family, the Vintoniidae, within the order Keratosida. The new family is distinguished by a well-defined ectosome and large, sack-shaped flagellate chambers, which empty into the large simple spongocoel.—Authors' abstract

Norton, S. A. *See* Hatch, N. L., Jr. 7765

Novotny, Robert T. *See* Cook, Kenneth L. 7831

Nowacki, W. *See* Wuensch, B. J. 8216

7820 **Nussmann, David George.** Trace elements in the sediments of Lake Superior [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 520B, 1966.

7800 **Nuzman, Carl E.** Electric analog models—Use in groundwater management: Jour. Soil and Water Conserv., v. 21, no. 4, p. 127–129, illus., 1966.

An electric analog model is a relatively new engineering tool to analyze ground-water flow. The two types of ground-water systems, steady-state and nonsteady-state each require a different type of model. Defining the type of system is part

of the model analysis. Both models are described. Application of the models to several hydrologic problems, as well as their limitations are given, the most serious limitation being in simulating unconfined or water-table aquifers.—E.S.L.

Oda, Uteana. *See* Erickson, R. L. 8189

Odé, H. *See* Biot, M. A. 8178

7999 **Ohmoto, H.; Hart, S. R.; Holland, H. D.** Studies in the Providencia area, Mexico—[Pt.] 2, K-Ar and Rb-Sr ages of intrusive rocks and hydrothermal minerals: Econ. Geology, v. 61, no. 7, p. 1205-1213, illus., tables, 1966.

The K-Ar age of biotite from the granodiorite stocks is 40.0 m.y., of muscovite from sulfide ore 34.5 m.y., and of adularia from late hydrothermal veins 38.0 m.y., all ±2 m.y. Rb-Sr values lie on a single isochron with an age of 41.0 m.y. These results suggest a maximum interval of 3 m.y. between granodiorite emplacement and mineralization. Initial value of Sr-87/Sr-86 is 0.705±0.001 for granodiorite stocks, muscovite from sulfide ore, and late albite-adularia mixtures. A genetic association between intrusive rocks and hydrothermal minerals is inferred.—W.S.W.

8180 **Oilweek.** Offshore oil potential rivals western Canada: Oilweek, v. 17, no. 27, p. 30-31, 34-35, 41-42, illus., 1966.

While the volume of accessible sedimentary rocks offshore is somewhat less than the volume onshore, much of it will be a more oil-productive type. In the absence of any detailed geologic knowledge, a conservative statistical approach is used to estimate oil reserves and areal geology on the Atlantic Coastal Plain. Geology of the coast off British Columbia demonstrates a striking similarity between basins strung along the entire Pacific coast, and a thick Tertiary section is thought to continue from Washington to Alaska. Production from California basins is reviewed and estimates made for Hecate basin, Vancouver Island shelf, and Georgia basin. The graben structure and Tertiary stratigraphy of Hecate basin are discussed; known geology and exploration programs in the Hudson Bay area are reviewed.—E.S.L.

Okazaki, R. *See* Smith, H. W. 7888

7773 **Oliver, William A., Jr.** Bois Blanc Formation, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244-A, p. A46-A48, 1966.

7774 **Oliver, William A., Jr.** Clarence Member of the Onondaga Limestone, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244-A, p. A48-A49, 1966.

8101 **Olsen, Edward; Mueller, Robert F.** Stability of orthopyroxenes with respect to pressure, temperature, and composition: Jour. Geology, v. 74, no. 5, pt. 1, p. 620-625, illus., 1966.

Equations are presented for the stability relations of the fayalite-quartz-orthoferrosillite assemblage in the α- and β-quartz fields and over a range of temperatures and pressures. They indicate that equilibrium pressure is lessened by 2 kb/0.1 increase in Mg/Mg+Fe, assuming ideal solutions. The effect is even greater for the probable non-ideal behavior of the orthopyroxene.—R.E.W.

Olsen, H. W. *See* Smith, W. O. 7886

8002 **Ong, H. Ling; Swanson, Vernon E.** Adsorption of copper by peat, lignite, and bituminous coal: Econ. Geology, v. 61, no. 7, p. 1214-1231, illus., tables, 1966.

Laboratory experiments indicate that, from dilute solutions (0-50 ppm), peat rapidly (20 minutes) adsorbs about 98 percent of the copper, lignite about 66 percent, and coal about 7 percent. "Maximum copper contents attained by peat, lignite, and bituminous coal were 1, 0.6, and 0.005 percent, respectively." Adsorption is most efficient at plt values between 3 and 8. Organic matter from which humic acid is removed adsorbs more copper than organic matter containing humic acid. The

amounts of metal adsorbed increases with surface area and ionic potential of the catron. As much as 2.2 percent copper in peat or lignite can be explained by adsorption from natural percolating waters.—W.S.W.

7966 **Ontario Department of Mines.** (Editorial Unit, compiler). List of publications, V. 1, 1891–1965: Ontario Dept. Mines Bull. 25 (11th edition), 112 p., illus., 1966.

Ordway, Frederick I., 3d. *See* MacGowan, Roger A. 7801

Osberg, P. H. *See* Hatch, N. L., Jr. 7765

8239 **Ostic, Ronald G.** The concentration and isotopic composition of lead in Toluca iron meteorite: Jour. Geophys. Research, v. 71, no. 16, p. 4060–4063, tables, 1966.

Results of new measurements of the concentration and isotopic composition of lead from Toluca troilite–graphite are sufficiently precise to show that the lead extracted was primordial rather than radiogenic. The problem of radiogenic lead in Toluca will remain unsolved until systematic variations in the concentration and composition can be measured in spatially related samples.—D.B.V.

8247 **Otwell, W. L.; Johnson, H. S., Jr.; Heron, S. D.** The D. T. Duncan kaolin property, Richland and Kershaw Counties, South Carolina: South Carolina Div. Geology Geol. Notes, v. 10, no. 1, p. 12–15, illus., tables, 1966.

Clays suitable for buff brick or possibly for white ware when combined with feldspar, occur in the Middendorf Formation of Cretaceous age. The clay near the Duncan property is similar to the kaolin produced in Aiken County, but thinner and lower in brightness. In the Duncan area the Middendorf Formation, composed of white- to pink fine-to-coarse sands with lenses of sandy-to-silty kaolin, is overlain locally by thin remnants of Tertiary(?) quartz pebble conglomerate. Loose sands, in part eolian, cap the hilltops and a colluvial blanket veneers the valley slopes. The lower brightness of the kaolin may be due to the absence of the clayey Eocene overburden which protects the Aiken clays from downward percolating iron bearing ground water. A sketch map indicates the geology and topography of the Duncan property.—G.D.C.

8176 **Outmans, H. D.** Discussion on "Theory of gravity instability with variable overburden and compaction", by M. A. Biot and H. Odé [1965]: Geophysics, v. 31, no. 4, p. 829–830, 1966.

Outmans objects to Biot and Odé's assumption (ibid., v. 30, no. 2, p. 213–227, 1965) that salt flows as a Newtonian viscous material, citing evidence that in reality it flows as a solid. Certain contradictory statements in the paper in question are also pointed out.—D.B.V.

8119 **Pablo, Liberto de.** A disordered kaolinite from Concepción de Buenos Aires, Jalisco, Mexico, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 143–150, illus., table, 1966.

A random-layer disordered clay mineral resembling kaolinite, found in a lignite deposit, gives an X-ray diffraction pattern which resembles halloysite. Computed interplanar distances are tabulated, and chemical analyses and infrared absorption spectra given. Electron microscopy reveals a morphology not characteristic of either kaolinite or halloysite. The data are insufficient to discuss in detail the relationships of the mineral to kaolinite or halloysite.—E.S.L.

Palmer, A. R. *See* Barnes, Virgil E. 8252

Pany, Frank G. *See* Tackett, Stanford L. 8224

7970 **Papike, J. J.; Stephenson, Neville C.** The crystal structure of mizzonite, a calcium- and carbonate-rich scapolite: Am. Mineralogist, v. 51, no. 7, p. 1014–1027, illus., tables, 1966.

The crystal structure of a 70.1 percent meionite scapolite (mizzonite, $a = 12.169 \pm 0.004$ and $c = 7.569 \pm 0.003$ A) from Grenville, Quebec has been refined in space group I4/m using three-dimensional X-ray intensities collected by integrated Weissenberg film techniques. Starting with positional parameters of a refined marialite scapolite structure reported by Papike and Zoltai (1965), the model was completed by Fourier methods and refined by least squares. The refined structure is basically the same as that of marialite with interesting differences concerning the aluminum distribution in the tetrahedral framework and the crystal-chemical role of the carbonate ion. . . .—Authors' abstract

Papike, J. J. *See* Clark, Joan R. 8222

7778 **Park, C. G., Jr.** Memorial to Roy Angus Macdiarmid (1933–1966): Geol. Soc. America Bull., v. 77, no. 9, p. P191–P192, 1966.

7807 **Parks, George A.; Tieh, Thomas T.** Identifying the geographical source of artefact obsidian: Nature, v. 211, no. 5046, p. 289–290, illus., table, 1966.

As the Sr/Rb concentration ratio in rocks is determined by the origin and age, it should be diagnostic of material from a given locality and thus provide a method of identifying the geographic source of obsidian artifacts. Preliminary experiments designed to test this hypothesis, reported here, have yielded encouraging results.—D.B.V.

8010 **Parks, James M.** Cluster analysis applied to multivariate geologic problems: Jour. Geology, v. 74, no. 5, pt. 2, p. 703–715, illus., tables, 1966.

Cluster analysis is a useful technique for analyzing large tables of geologic data where many different measurements are made on each of many samples. A computer program has been written in MAD language which gives the results of the cluster analysis in the form of a two-dimensional hierarchial diagram so that natural groupings of the samples are given for any desired level of similarity. The cluster analysis can also be made on estimates of factors obtained from an R-mode factor analysis, by using distance coefficients as a measure of similarity.—A.T.M.

Pask, J. A. *See* Langston, R. B. 8121

7819 **Patton, Franklin Davis.** Multiple modes of shear failure in rock and related materials [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 520B, 1966.

Patton, John B. *See* Wier, Charles E. 7894

Pauken, Robert. *See* Unklesbay, A. G. 8234

8248 **Paul, Roger A.; Day, Walter C.** Trace elements in common rock types and their relative importance in neutron-induced radioactivity calculations: U.S. Atomic Energy Comm. Rept. PNE-5006, 35 p., illus., tables, 1966.

The chemical composition of rock surrounding an underground nuclear detonation must be known or assumed when calculations of resulting neutron-induced radioactivity are attempted. A literature search was undertaken to determine the average and range of content of 15 trace elements with high neutron-capture cross sections. Their content in ten igneous and three sedimentary rock types is given. The elements, Gd, Eu, Sm, B, and Cl were found to occur in quantities which would significantly affect neutron-induced radioactivity calculations. Calculations were performed for granite using maximum, average, and minimum trace-element values obtained from the literature search, also for four other igneous rocks and two sedimentary rocks using average values. It is concluded that use of average values is adequate for assessing the production quantities of radionuclides induced external to the device in underground nuclear detonations.—*from* Authors' abstract

7776 **Pavlides, Louis.** Meduxnekeag Group and Sprague ville Formation of Aroostook County, northeast Maine, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244-A, p. A52–A57, illus., table, 1966.

7987 **Pearson, Robert C.; Hedge, C. E.; Thomas, H. H.; Stern, T. W.** Geochronology of the St. Kevin Granite and neighboring Precambrian rocks, northern Sawatch Range, Colorado: Geol. Soc. America Bull., v. 77, no. 10, p. 1109–1120, illus., tables, 1966.

A whole rock Rb–Sr isochron age on the St. Kevin Granite is 1,390±60 m.y. Mineral ages on the St. Kevin and on associated geologically "Ancient" paragneiss and migmatite are either about the same as this whole rock age or as much as 200 m.y. younger. Mica ages on rocks known to be geologically older than the St. Kevin are low and are interpreted as ages modified by heat from the intruding granite.—R.G.Y.

8059 **Pelzer, E. E.** Mineralogy, geochemistry, and stratigraphy of Besa River Shale, British Columbia: Bull. Canadian Petroleum Geology, v. 14, no. 2, p. 273–321, 1966.

The Besa River Formation of Middle Devonian (Givetian) to Late Mississippian (Chester) age ranges in thickness from less than 1,000 to more than 7,000 feet. The thinner sections, which were continuously deposited in deep water represent the fondothem. Thicker sections on the east and south represent the clinothem. Barrier reef complexes, blanket shelf carbonates, and interbedded calcareous shale and limestone represent the undathem. The predominant fraction of the shale, comprising quartz, carbonate, pyrite, and carbonaceous matter is indigenous to the basin of deposition and is largely of organic or chemical origin. The subordinate clay fraction was either derived from volcanic ash and moved to shelf margins or was generated within the basin from dilute solutions of its constituents. Depth of water is not critical to formation of thin transgressive black shales.—C.A.S.

7984 **Peterman, Zell E.** Rb–Sr dating of middle Precambrian metasedimentary rocks of Minnesota: Geol. Soc. America Bull., v. 77, no. 10, p. 1031–1043, illus., tables, 1966.

Unaltered argillite and siltstone of the Mahnomen Formation, metamorphosed to the greenschist facies, yield a 1.75 b.y. isochron age which probably represents loss of radiogenic Sr by regional metamorphism during the Penokean orogeny. Altered parts of the formation yield an isochron age of 1.46 b.y. which probably indicates a removal of radiogenic Sr, and also common Sr and Rb by postmetamorphic oxidizing solutions during enrichment of associated iron deposits. Similar, but lower grade, rocks of the Virginia, Rove, and Thomson Formations yield an isochron age of 1.57 b.y. which indicates they were probably open systems during waning phases of regional metamorphism. Comparison of initial Sr–87/Sr–86 ratios suggests a southern source for the Mahnomen Formation and a northern source for the others.—R.A.L.

8185 **Peterson, James A.** Stratigraphic vs. structural controls on carbonate-mound hydrocarbon accumulation, Aneth area, Paradox basin: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2068–2081, illus., 1966.

Pennsylvanian petroleum pools in southern Paradox basin are in algal carbonate mounds of Desmoinesian age elongated in a general northwest direction along the basin shelf. Carbonate reservoirs are associated closely with sapropelic black shale and evaporite, which occur in cyclic repetition in the shelf area and grade basinward to a predominantly salt section. All reservoirs appear to be isolated bodies of porous carbonate, mostly limestone. About 30 fields productive from the Pennsylvanian have been found; about half are classed as stratigraphic and the other half as either structural or structural–stratigraphic. In almost all fields it can be demonstrated that accumulation would have formed even if no structural closure were present. Aneth, Ismay, and Cache fields are good examples showing major stratigraphic and only minor structural influence on accumulation.—S.P.S.

7953 **Pevear, David R.** The provenance and distribution of phosphorite in coastal and shelf sediments of Georgia, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, p. 67–70, illus., 1966.

Phosphorite sand grains comprise about one to four percent of modern shelf, beach, and estuarine sands. The phosphorite is not being contributed by present-day rivers, and the Pleistocene barrier island sands are nonphosphatic. However, modern beaches on the east contain high amounts of phosphorite, and apparently these beach and estuarine sands originated by landward transport from the shelf.—E.S.L.

8053 **Pfleider, Eugene P.; Berger, Fred E.; Wallen, Donald A.** (editors). 27th annual mining symposium and 39th annual meeting of the Minnesota Section, AIME, Duluth, Minn., 1966: Minneapolis, Minn., Univ. Minnesota, Nolte Center Continuing Education, 196 p., illus., tables, 1966.

This publication presents the papers of six technical sessions and two seminar sessions on problems and developments in the mining industry. Of these, three which deal with porphyry-copper deposits, nuclear potential for overburden stripping, and kaolinite adsorption of surfactants are separately cited.—G.D.C.

7863 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the Ellsworth quadrangle, Litchfield County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-583, scale 1:24,000, 1966.

7864 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the Cornwall quadrangle, Litchfield County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-584, scale 1:24,000, 1966.

7865 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the Spring Hill quadrangle, Tolland and Windham Counties, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-585, scale 1:24,000, 1966.

7866 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the South Coventry quadrangle, Tolland County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-586, scale 1:24,000, 1966.

7867 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the Torrington quadrangle, Litchfield and Hartford Counties, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-589, scale 1:24,000, 1966.

7868 **Philbin, P. W.; Smith, C. W.** Aeromagnetic map of the West Torrington quadrangle, Litchfield County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-590, scale 1:24,000, 1966.

7788 **Pilkey, Orrin H.; Harriss, Robert C.** The effect of intertidal environment on the composition of calcareous skeletal material: Limnology and Oceanography, v. 11, no. 3, p. 381-385, illus., tables, 1966.

Oysters and barnacles were collected in the intertidal zone from four pilings within the estuary system near Sapelo Island, Ga. The calcareous skeletal material was analyzed for Sr, Fe, Mg, Na, and Mn. Distinct and regular differences in skeletal composition were found. Sr and Mn exhibit some particularly close linear relationships between composition and piling level. Mg is the only element for which no linear relationship was observed.—Authors' abstract

7939 **Pilkey, Orrin H.; Frankenberg, Dirk.** The relict-Recent sediment boundary on the Georgia continental shelf, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 4 p., paged separately, illus., reprinted 1966; originally published 1964.

A bottom sampling program has delineated the Pleistocene-Recent boundary on the Georgia continental shelf. Recent sediments are dominantly fine-grained and gray, and Pleistocene are medium to coarse yellow sands. The boundary line is quite sharp and marked by a zone of interfingering, 2 to 4 mi wide, at a consistent depth of about 6 fathoms. The distinction between sediments ends at the mouth of the St. Johns River in Florida.—E.S.L.

7941 **Pilkey, Orrin H.; Richter, Dennis M.** Beach profiles of a Georgia barrier island, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 9 p., paged separately, illus., reprinted 1966; originally published 1964.

Seasonal beach profiles were obtained from seven stations at the south end of Sapelo Island during 1963. Except for accretion at the extreme south tip of the island, most of the study area is being eroded. Unlike other beaches reported in the literature, the seasonal and observed storm changes of the Sapelo Island beach are slight.—Authors' abstract

7951 **Pilkey, Orrin H.** The size distribution and mineralogy of the carbonate fraction of United States South Atlantic shelf and upper slope sediments, *in* Pleistocene and Holocene sediments, . . . —Geol. Soc. America S.E. Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 16 p., illus., tables, reprinted 1966.

The carbonate fraction from 70 sediment samples was studied. Mollusks are the principal contributors on the shelf, while Foraminifera are most important on the slope. On the shelf, the carbonate fraction is highly fragmented and worn, whereas slope carbonate materials tend to be in good condition. Two distinct physical-condition assemblages can be discerned on the shelf, indicating dual sources or ages. Removal of the carbonate fraction results in better sorting and finer mean grain sizes in both environments. Mineralogy of the slope is more variable than the shelf, but no obvious environmental effects were observed. Distribution maps and histograms are included, and deviation of mineralogy is tabulated. This paper was originally published in 1964.—E.S.L.

7952 **Pilkey, Orrin H.; Terlecky, P. Michael.** Distribution of surface sediments on the Georgia continental shelf, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America Southeastern Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, p. 28–39, illus., 1966.

Over 200 sediment samples were collected from the continental shelf of Georgia along east-west traverses. Areal distribution of the seven sediment types is shown on a series of maps, drawn on the assumption that sediments were deposited during the last sea-level transgression as a series of beaches or nearshore deposits. The Recent-relict sediment boundary is about 12 mi offshore at a depth of about 10 m. The carbonate fraction becomes much more abundant at the shelf edge. Ages of the various bands parallel to the shoreline, source of the nearshore fines, and meaning of the Recent-relict boundary are questions remaining to be answered.—E.S.L.

Pilkey, Orrin H. *See* Harriss, Robert C. 8147

8336 **Pilkey, Orrin H.** Heavy minerals of the U.S. South Atlantic continental shelf and slope, *in* Pleistocene and Holocene sediments, Sapelo Island, Georgia, and vicinity—Geol. Soc. America SE Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 8 p., paged separately, illus., reprinted 1966; originally published 1963.

In comparison with other areas such as the Gulf of Mexico shelf, both qualitative and quantitative variation in heavy minerals of the U.S. southern Atlantic shelf and slope is subdued, mainly due to similar provenance areas for most major rivers. Two heavy-mineral provinces can be defined, based on epidote content, with the boundary extending southeast from Cape Fear, N.C. A close areal relationship between capes and certain heavy-mineral anomalies was noted indicating that processes forming the capes and their associated seaward-extending shoals are important in sediment distribution. Roundness observations were made on garnet, kyanite, staurolite, and tourmaline grains. Garnet and kyanite exhibit strong roundness anomalies, both minerals being better rounded in the northern portions of the area. Roundness-distribution histograms indicate dual-sediment sources in some instances.—*from* Author's abstract

8037 **Pinckney, Darrell M.** Structural and chemical ore controls in the Cave-in-Rock district, Illinois [abs.]: Econ. Geology, v. 61, no. 7, p. 1304, 1966.

Poole, W. H. *See* Geological Association of Canada. 8330

Potter, P. E. *See* Carr, D. D. 8244

Potter, R. R. *See* Greiner, H. R. 8039

7904 **Powell, Richard L.** Caves—Speleology and karst hydrology, *in* Natural features of Indiana—Symposium, 1966 (Indiana Sesquicentennial Volume, 1816–1966): Indianapolis, Ind., Indiana Acad. Sci., p. 116–130, illus., 1966.

About 700 caves have been discovered in southern Indiana; the Blue Springs Cave in Lawrence County is the fifth longest in the United States, and the eighth longest in the world. Caverns and associated karst features are common in south-central Indiana in a glaciated area where Silurian and Devonian limestones crop out, and in a partly glaciated area where the surface rocks are Mississippian limestones. Limestone underlies much of Indiana's bedrock surface, but five-sixths of the State is veneered with glacial drift which obscures perhaps thousands of preglacial caverns. Some 30 known caves in the eastern karst are mostly small and only a few have been mapped. The development of karst features is described briefly, with examples from the various areas. A generalized geologic cross section related to physiographic units is included.—G.D.C.

7934 **Powell, Richard L.** Groundwater movement and cavern development in the Chester Series in Indiana: Indiana Acad. Sci. Proc. 1965, v. 75, p. 210–215, illus., 1966.

Caves are abundant along the outcrop of various West Baden and Stephensport Group limestones of the Crawford Upland. Ground water enters the limestone from perched water tables in the overlying sandstones by way of joints, and the underlying shales cause the water to flow along the base of the limestone until it forms a spring at the outcrop. Nearness of caverns to the outcrop indicates a close relationship between amount of flow and proximity to outcrop. Ray Cave, the largest, is described.—E.S.L.

7968 **Prewitt, C. T.; Burnham, Charles W.** The crystal structure of jadeite, $NaAlSi_2O_6$: Am. Mineralogist, v. 51, no. 7, p. 956–975, illus., tables, 1966.

The crystal structure of naturally occuring pure jadeite has been refined by least-squares methods using single-crystal-X-ray intensity data obtained by counter-diffractometer techniques. This jadeite is monoclinic, space group C2/c, with cell dimensions $a = 9.418$ A, $b = 8.562$ A, $c = 5.219$ A, and $\beta = 107.58°$ The structure is similar to that of the pyroxene diopside and contains parallel sheets of octahedrally coordinated aluminum and 8-coordinated sodium polyhedra connected by silicate chains running parallel to the *c* axis. The mean cation-oxygen distances are Si-O 1.623 A, Al-O 1.928 A, and Na-O 2.469 A.—Authors' abstract

8208 **Price, Paul H.** The mineral resources potential in West Virginia: West Virginia Geol. Survey Newsletter, 9th issue, p. 3–6, 1966.

The principal mineral resources of West Virginia are: coal, principally a mineral fuel but used more extensively as a raw material; natural gas, mainly from Devonian rocks, but possibly also from Ordovician and Silurian strata; petroleum, now in the secondary recovery phase; limestone, relatively undeveloped; building stone, mostly sandstone and limestone; sand and gravel, especially glass sand; salt, mainly in the Kanawha Valley; clay, for manufacture of face brick, paving tile, and similar products; water, for domestic, agricultural, industrial, and recreational uses; and mineral springs.—M.C.M.

7804 **Pride, R. W.; Meyer, F. W.; Cherry, R. N.** Hydrology of Green Swamp area in central Florida: Florida Geol. Survey Rept. Inv. 42, 137 p., illus., tables, 1966.

Green Swamp is an area of about 870 sq mi near the center of the peninsula. The surface is mantled with a varying thickness of sand and clay which acts as a nonartesian aquifer. Porous marine limestones of Eocene–Miocene age comprising the Floridan aquifer outcrop in the west and reach a depth of 50–200 feet in the east. Hydrologic data were collected for four years to analyze the budget and determine the significance of the area in central Florida hydrology. Higher rates of ground-water recharge to the aquifer occur in the east. Impoundment of discharge in the Green Swamp Reservoir would reduce floods in Tampa, but have little effect on ground-water outflow, because the aquifer is full already. Structure contour and ground-water maps accompany the report.—E.S.L.

Pryslak, A. P. *See* Davies, J. C. 8197

Pryslak, A. P. *See* Davies, J. C. 8198

Pryslak, A. P. *See* Davies, John C. 8199

8213 **Puig de la Parra, Juan B.** Aplicación de la geología a la construcción de vías terrestres: Geología y Metalurgía, v. 2, no. 15, p. 5–12, 1966.

The importance of geological knowledge in civil engineering work is emphasized, particularly in the planning, projecting and construction of highways. The progressive steps are outlined, as well as some details of geological research for problems such as bridges and tunnels, roadbed location, and for the use of photogeologic mapping on scales of 1:50,000, 1:10,000 or 1:5,000. Speed is an important factor in the revision of techniques, for which the use of airphotos is most desirable.—G.D.C.

8233 **Radinsky, Leonard B.** A new genus of early Eocene tapiroid (Mammalia, Perissodactyla): Jour. Paleontology, v. 40, no. 3, p. 740–742, illus., 1966.

Selenaletes scopaeus, a new genus and species of helaletid, is based upon a lower jaw fragment, probably from Lost Cabin beds, Wind River Basin, Wyo. Other material from Wyoming and Colorado provides knowledge of DP_4 and $P_4 - M_3$. Generic diagnosis is: tiny, with relatively unmolariform premolars, lower molars similar to those of *Heptodon* except much smaller and with M_3 smaller than M_2 and lacking a hypoconulid. *Selenaletes* apparently is the smallest known perissodactyl.—F.C.W.

Radoslovich, E. W. *See* Burnham, Charles W. 8143

7796 **Ramdohr, Paul.** Reflected light microscopy in the investigation of ore deposits—An introduction and a review, *in* Applied ore microscopy—Theory and technique (1st English edition): New York, Macmillan Co., p. 195–316, illus., tables, 1966.

The association of the principal technologically important minerals is discussed, stressing geologic thermometry and indicator minerals, examples of which are tabulated. Common types of magmatic ore deposits described include four types of magmatic differentiates, three pegmatitic-pneumatolytic deposits, and seven hydrothermal deposits. All are illustrated by photographs of polished sections. Under sedimentary deposits, placers, oxidation and secondary enrichment, the sulfur cycle, oolitic iron ores, and manganese oxide ores are treated, and photographs and drawings are given. Metamorphic deposits are not subdivided. Sections on determination of the ore minerals, intergrowths, and quality of the polished sections conclude the paper.—E.S.L.

7797 **Ramdohr, Paul; Rehwald, Gerhard.** The selection of ore specimens and the preparation of polished sections, *in* Applied ore microscopy—Theory and technique (1st English edition): New York, Macmillan Co., p. 317–380, illus., tables, 1966.

Selection of specimens and their preparation for grinding and polishing, along with some of the earlier procedures, are reviewed. The Rehwald–Vanderwilt grinding and polishing method is emphasized, and the discussion includes description of the machine, its use, and mounting of ore specimens. Almost relief-free polished sections can be made by this method, even on heterogeneous material. Polished

sections of grain samples can also be prepared, and sampling, classification by grain size, concentration by physical methods, and methods of mounting are discussed.—E.S.L.

7798 **Ramdohr, Paul.** The microscopical investigation of primary uranium minerals, *in* Applied ore microscopy—Theory and technique (1st English edition): New York, Macmillan Co., p. 539–554, illus., 1966.

The minerals of U^{+4} are divided into three groups; the first contains uranium carriers with 0.1 or less percent U, the second, metamict minerals, and the third, minerals containing uranium as an essential component. The last group is of economic interest, and six minerals, uraninite, coffinite, brannerite, davidite, ningyoite, and thucolite, are described, and their appearance on polished sections illustrated.—E.S.L.

7857 **Raup, David M.** Geometric analysis of shell coiling—General problems: Jour. Paleontology, v. 40, no. 5, p. 1178–1190, illus., 1966.

Among the shells of invertebrates that exhibit spiral growth, differences in form can be expressed by differences in geometric parameters. If three parameters are considered at a time, the spectrum of possible shell forms may be shown by a block diagram. Analog and digital computer constructions make it possible to visualize shell forms that are theoretically possible but do not occur in nature. Actual species are not randomly distributed in the total spectrum of theoretically possible forms. Functional and evolutionary groups are confined to discrete regions of the spectrum. For example, a bivalve must have non-overlapping whorls in order to have a functional hinge. This fact restricts the geometric range of both brachiopods and bivalved molluscs. Ontogenetic change in coiling geometry may be interpreted as compensation for effects of increase in absolute size during growth.—*from* Author's abstract

8130 **Rayner, J. H.; Brown, G.** Structure of pyrophyllite, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 73–84, illus., tables, 1966.

Pyrophyllite gives a diffraction pattern consisting of sharp and diffuse reflections. The unit cell for all the reflections is monoclinic with a = 5.17 A, b = 8.92 A, c = 18.66 A, $\beta = 99.8°$. From the absences, the space group is either C2/c or Cc. Additional systematic absences show that the structure is partly disordered, the disordered state being based on a small subcell defined by the sharp reflections. This subcell is monoclinic, and belongs either to the space group Cm or C2/m. The Si—O tetrahedra are twisted 10°–10.5° from the ideal arrangement, leading to a ditrigonal array of oxygens on the surfaces of the layers. [Atomic contents and sites, and atomic coordinates, for the pyrophyllite subcell are tabulated].—*from* Authors' abstract

Reed, M. G. *See* Scott, A. D. 8126

Reesman, A. L. *See* Keller, W. D. 8134

8102 **Reeves, C. C., Jr.** Pleistocene climate of the Llano Estacado, [Pt.] 2: Jour. Geology, v. 74, no. 5, pt. 1, p. 642–647, illus., table, 1966.

A combination of increase in precipitation, decrease in evaporation, and increase in runoff would be needed to restore Cary-age pluvial lake levels in West Texas, rather than only an increase of runoff as previously suggested (1965) by the writer.—D.R.M.

Rehwald, Gerhard. *See* Ramdohr, Paul. 7797

7842 **Reshkin, Mark.** Lake Chicago sediments in northwestern Indiana [abs.]: Indiana Acad. Sci. Proc. 1965, v. 75, p. 149–150, 1966.

8124 **Rex, R. W.; Bauer, W. R.** New amine reagents for X-ray determination of expandable clays in dry samples, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 411–418, illus., tables, 1966.

Amine-montmorillonite complexes were reviewed for compounds suitable for routine use as expanding agents for X-ray determination of montmorillonites, and four were found that met requirements. They are formate and acetate salts of tri-n-hexylamine and dimethylbenzylamine, which yielded expanded montmorillonite with first-order basal spacings of 18.1 A, essentially the same as the currently used glycerine complex. Detailed studies of tri-n-hexylammonium formate and acetate suggest that they are stable with time and produce a homo-ionic, nonhygroscopic clay. The complex yields an intense peak useful for quantitative analysis. Furthermore, the reagent is satisfactory for use with both oriented aggregate slides and for random packing mounts.—Authors' summary

8132 **Rex, R. W.** Authigenic kaolinite and mica as evidence for phase equilibria at low temperatures, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 95–104, illus., tables, 1966.

Electron micrograph, X-ray diffraction, and chemical studies of secondary clay minerals formed within sandstones provide data supporting a portion of the phase relationships proposed by Garrels (Garrels and Christ, 1965) for kaolinite and K-mica growing in equilibrium with K-feldspar and quartz at about 25°C. A true phase distinction between mica and kaolinite is found at the phase boundary and not a continuous solid-solution series, such as proposed by Keeling (1961). Some of the micas, however, show evidence for the presence of an interlayer impurity, such as small amounts of hydroxymagnesium cation proxying for K^+. Electron micrographs and diffraction studies show epitaxial growth of oriented mica crystals on kaolinite providing evidence for the existence of these two distinct phases in mutual equilibrium with the solution from which they crystallized.—Authors abstract

8229 **Rexroad, C. B.; Lane, H. R.** Clarification of *Cavusgnathus alta*, type species of the conodont genus *Cavusgnathus*: Jour. Paleontology, v. 40, no. 6, p. 1391–1392, illus., 1966.

A restudy of the types of *Cavusgnathus alta* and *C. cristata* shows that they are conspecific and the latter is a junior synonym. Specimens assigned to this species are all from rocks of Mississippian age.—R.C.D.

7935 **Reynolds, Albert E.** Two elephantine teeth from the Mill Creek drainage area: Indiana Acad. Sci. Proc. 1965, v. 75, p. 293–298, illus., 1966.

Two teeth discovered approximately two decades ago in Hendricks County, Ind., were identified as elephantine on the basis of their ridge-plate structure, and allocated to *Parelephas jeffersonii* on the basis of the discovery sites near Stilesville. Both teeth were described in quantified terms, and the approximate sites of discovery discussed briefly in relation to their proximity to Lake Eminence of the late Wisconsin glacial epoch.—Author's summary

8226 **Ribbe, P. H.; Cohen, L.** Newberyite and monetite from Paoha Island, Mono Lake: California Div. Mines and Geology Mineral Inf. Service, v. 19, no. 3, p. 46, illus., 1966.

The large crystal-like mineral specimens were found in a diatomite zone on Paoha Island about 80 feet above the Mono Lake water level. The monetite ($CaHPO_4$) coats the fragile blade-like crystals of newberyite ($MgHPO_4 \cdot H_2O$), pseudomorphous after struvite. Both are guano minerals. The monetite coating preserved the morphology when the struvite decomposed to newberyite. The island apparently was a rookery thousands of years ago.—E.S.L.

Rice, J. C. *See* Smith, W. O. 7886

8235 **Rich, Mark.** Mississippian trilobites from northwestern Georgia: Jour. Paleontology, v. 40, no. 6, p. 1381–1384, illus., 1966.

Abundant trilobite specimens were obtained from an outcrop of the Lavender Shale Member of the Fort Payne Chert (Mississippian) near Ringgold, Catoosa County, northwest Georgia. The forms represent one new species of *Australosutura* Amos, Campbell, and Goldring, *A. georgiana*, and at least two species of *Proetus* Steininger. The specimens were found in silty claystone and silty clay shale.—Author's abstract

Richardson, Eugene S., Jr. *See* Johnson, Ralph Gordon. 8068

Richter, Dennis M. *See* Pilkey, Orrin H. 7941

7928 **Ricketts, John A.; Delia, Anthony.** Quantitative differential thermal analysis as applied to the thermal decomposition of magnesite: Indiana Acad. Sci. Proc. 1965, v. 75, p. 163–166, illus., 1966.

The apparatus used was the Aminco thermoanalyzer, and thermographs were made on a series of mixtures of magnesite, calcite, and dolomite. Temperature was raised 20°C per minute within the range of 150° to 1,000°C. Results indicate that for magnesite and dolomite the predictions of the Vold–Speil equation are qualitatively observed; however, the calculated heat of decomposition for magnesite is low. Although DTA may not be useful as an absolute microcalorimetric tool in the study of carbonate decomposition, it is demonstrated that the technique is quite applicable to the determination of the magnesium content of limestones.—E.S.L.

Ried, Arch M. *See* Sinkankas, John. 8214

Rigby, J. K. *See* Nitecki, M. H. 8160

7854 **Rigby, J. Keith.** Microstructure and classification of an Ordovician sponge, *Dystactospongia madisonensis* Foerste, from Indiana: Jour. Paleontology, v. 40, no. 5, p. 1127–1130, illus., 1966.

Unusually well preserved microstructure is observable in a single specimen of the sponge *Dystactospongia madisonensis* Foerste for the first time. Ophiraphid(?) spicules form compact rope-like tracts in the silicified interior of a specimen from the Upper Ordovician Saluda Formation near Versailles, Ind. Canals are lined with curved spicules, oriented parallel to the canal surface, usually at angles to the length of the canals. Crepidal canals are not visible within the spicules, but this is not surprising in view of the chalcedonic preservation. The compact spicule mass has been replaced by coarsely crystalline calcite in the outer part of the present specimen and other specimens associated with it. *D. madisonensis* Foerste is considered a choristid demosponge.—Author's abstract

Roberson, Herman E. *See* Jonas, Edward C. 8111

8157 **Roberts, John F.** Developments in the Oklahoma portion of the Arkoma basin, 1960–1965: Oklahoma Geology Notes, v. 26, no. 7, p. 187–192, illus., 1966.

Annual natural-gas production and the total drilling in the Arkoma basin from 1960 through 1965 are given. A map shows the present gas fields in the basin, their productive zones, and relationships to major surface anticlinal axes. A selected bibliography of symposium-type publications each of which contains papers of both general and specific information about the Arkoma basin is included. Most of the papers contain comprehensive bibliographies.—B.S.H.

7959 **Roberts, Robert S.; Hodson, Warren G.** Ground water in Kansas—Bibliography and subject index: Kansas Geol. Survey Bull. 182, 41 p., 1966.

The bibliography comprises all published reports and selected unpublished reports including theses and open-file reports. The list is in two sections: *Bibliography*,

a listing by authors, in alphabetical order; and *Subject index*, with the Kansas counties in alphabetical order.—*from* Authors' introduction

Robinson, J. L. *See* Lundy, B. R. 8073

7983 **Robinson, Paul D.** Use of the binocular microscope for orientation of single crystals: Am. Mineralogist, v. 51, no. 7, p. 1243, 1966.

Cleavage or crystal faces are oriented normal to the axis of a goniometer head by observing, through one ocular, the maximum reflection of light passed downward through the other ocular.—B.C.H.

8256 **Roche C., Luis A.** Los minerales petrográphicos—Los feldespatos: Geología y Metalurgía, v. 2, no. 15, p. 41–72, illus., 1966.

Feldspars are tectosilicates, constituting about 60 percent of the silicates in the Earth's crust. Common characteristics of the several varieties observed under the microscope are outlined; simple and polysynthetic twinning are illustrated. General descriptions are given of macroscopic characteristics of orthoclase, microcline, sanidine, and plagioclase feldspars, perthitic forms, and twinning, and also some mineral associations in different types of rock. Different methods for the determination of plagioclases are summarized; the percentages of anorthite are illustrated by nomographs.—G.D.C.

8034 **Roedder, Edwin.** Significance and limitations of fluid inclusion thermometry [abs.]: Econ. Geology, v. 61, no. 7, p. 1298, 1966.

8207 **Rollo, J. R.** Ground-water resources of the greater New Orleans area, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. 9, 69 p., illus., tables, 1966.

The principal aquifer in the New Orleans area is the "700-foot" sand; two shallower and one deeper aquifer are of less importance. In 1963 average withdrawal from the "700-foot" was 51.2 mgd and is estimated to reach 90 mgd by 1980. Water grades from fresh to salty in a north to south direction, but salt-water encroachment is not deemed serious provided current distribution of pumping is maintained. Wells yielding 1,000 gpm or more can be constructed in this aquifer anywhere within the area. Because of its yellow color, water has never been considered satisfactory for public supply unless treated by chlorination. Maps of aquifers and their properties, and a fence diagram are in a separate folder.—M.C.M.

7871 **Rosholt, J. N.; Doe, B. R.; Tatsumoto, M.** Evolution of the isotopic composition of uranium and thorium in soil profiles: Geol. Soc. America Bull., v. 77, no. 9, p. 987–1003, illus., tables, 1966.

Mass spectrometric and alpha-spectrometric analyses were made for U-238, U-235, U-234, Th-232 and Th-230 in several soil profiles of varied age and climatic regime. A model was developed to explain U and Th isotopic distribution, the principal features of the model being: 1) general leaching throughout of U; 2) preferential leaching of U-234; 3) upward capillary migration of a fraction of the U with above normal U-234/U-238 which may subsequently become fixed in organic matter. The role of geochemical processes of distribution as well as radioactive decay is emphasized.—J.J.H.

8165 **Ross, J. P.** *Stictopora* Hall 1847 (Ectoprocta, Cryptostomata), a valid name: Jour. Paleontology, v. 40, no. 6, p. 1400–1401, 1966.

Stictopora Hall 1847 was used in 1948 by Dreyfuss and in 1960 by Ross. It has not remained unused as a senior synonym for 50 years and is, therefore, a valid name.—R.C.D.

7808 **Ross, June Phillips.** Early Ordovician ectoproct from Oklahoma: Oklahoma Geology Notes, v. 26, no. 8, p. 218–224, illus., 1966.

A ceramoporoid cyclostomate bryozoan, *Ceramopora? unapensis*, new species, from the Early Ordovician Kindblade Formation in the Wichita Mts. is described and illustrated. This bryozoan is significant because it is the first recorded occurrence from the Arbuckle Group, the oldest known from Oklahoma, and the first early Ordovician bryozoan found in North America.—B.S.H.

8129 **Ross, Malcolm.** The torbernite minerals as model compounds for the hydrous layer silicates, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 65–71, illus., 1966.

Crystal-structure analyses of abernathyite and two other torbernite group compounds shows that all three have interlayer structures formed by hydrogen bonding of water molecules into infinite sheets composed of four- and eight membered rings. The interlayer K, NH_4, H_3O ions are randomly distributed over water molecule sites, giving an extremely flexible structural scheme, which may apply to the expanding layer silicates. For these minerals the potassium and ammonium analogs usually do not fully contract to the 10 A basal spacing on immersion in K or NH_4 solutions, but rather obtain a spacing of 11–14 A. A projection of the abernathyite structure on (100), and a representation of the interlayer structure as linked OH_3 tetrahedra, are given.—E.S.L.

8133 **Ross, Malcolm.** Precision unit-cell parameter determination of layer silicates by use of electron and X-ray diffraction powder techniques [abs.], *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 105–106, 1966.

Rowe, Jack J. *See* Fournier, Robert O. 8033

8027 **Runnels, Donald D.** Mineralization of the Ruby Creek (Bornite) copper deposit, Cosmos Hills, Alaska [abs.]: Econ. Geology, v. 61, no. 7, p. 1305, 1966.

Ruotsala, A. P. *See* Tobias, T. J. 8122

Russell, J. R. *See* Ahlrichs, J. L. 7893

8084 **Russell, Paul L.** Nuclear blasting and its potential for stripping overburden, *in* Mining Symposium, 27th Ann., and AIME, Minnesota Sec., 39th Ann. Mtg., Duluth, 1966: Minneapolis, Minn., Univ. Minnesota, Nolte Center Continuing Education, p. 145–151, illus., table, 1966.

Cratering experiments have demonstrated the ability of nuclear explosives to move vast volumes of earth and rock. Application to mining and excavation received early consideration; potentially, excavation is perhaps the best understood, and the compact size of nuclear explosives for very high energy yield offers economic and time advantages. Release of radioactivity in cratering is generally small compared with above-ground explosions of similar yield, so their use in selected isolated areas should present no danger where topography and ground-water conditions are favorable and population density low. Nuclear explosives may be of potential use in stripping of overburden from copper or iron deposits, but does not appear to be practical for stripping of coal. Possible methods of application are considered.—G.D.C.

8064 **Salwen, Bert.** Sea levels and Archaic archaeology of the northeast coast of the United States: Coastal Research Notes, v. 2, no. 2, p. 9–10, 1966.

It has been suggested that Archaic cultures along the northeast coast of the United States failed, over thousands of years, to exploit the abundant shellfish resources. An alternative explanation is that sea levels were from 10 to 40 feet below present levels in Archaic times, and sites now on the shore were inland. Geological data on sea levels are correlated with archeological materials; many sites are considered briefly, and 16 in detail. Shellfish debris is found in those sites that had been close to the shoreline but were not drowned by the rising levels.—E.S.L.

Samson, Sten. *See* Gordon, E. Kent. 8251

7840 **Sanders, Robert B.** The *incertae sedis* group Tegmates revealed as plates of a chiton: Jour. Paleontology, v. 40, no. 5, p. 1240–1241, 1966.

Three genera of Rhoads, *Triangulata*, *Bursata*, and *Subcylindrica*, from the Ordovician Maquoketa Shale of Iowa are plates of a 7 or 8 plated chiton *Septemchiton iowensis* (Rhoads).—R.E.G.

8162 **Sanderson, G. A.** A bibliography of the family Fusulinidae, addendum 3: Jour. Paleontology, v. 40, no. 6, p. 1402–1408, 1966.

Addendum 3 contains 184 references dealing with the family Fusulinidae. The majority of the entries are from 1964–1966. Thirty-seven percent of the references listed were published prior to 1964.—R.C.D.

Sarabia, Juan M. *See* Coffin O., José. 7792

Sasaki, A. *See* Folinsbee, Robert E. 8032

8024 **Sato, Motoaki.** Electrochemical method of geothermometry for ore and gangue minerals [abs.]: Econ. Geology, v. 61, no. 7, p. 1301, 1966.

Sauer, F. M. *See* Eisler, J. D. 8193

Saum, N. M. *See* Keller, W. D. 8134

8260 **Savage, J. C.** Thermoelastic attenuation of elastic waves by cracks: Jour. Geophys. Research, v. 71, no. 16, p. 3929–3938, illus., 1966.

Zener's theory of thermoelastic attenuation by inhomogeneities is applied to a medium containing cracks. Energy losses per wave cycle are calculated for two-dimensional hydrostatic pressure and for shear. Absorption spectrums vary less than an order of magnitude over a frequency range of more than 10^4 cps. The Q values for longitudinal (Q_{lambda}) and transverse (Q_{beta}) waves are derived in terms of parameters measured in static testing. For granite the theoretical values are about twice the experimental, but the difference is not significant due to large uncertainties in some parameters. The theory also predicts that Q_{lambda}/Q_{beta} should be near 1/2 for most rocks, which have been observed in the laboratory, and a temperature dependence of Q which has not been observed.—D.B.V.

7910 **Scheele, William E.** Post-glacial Ohio: Explorer, v. 8, no. 3, p. 10–11, illus., 1966.

Natural resources traceable to the ice age are Lake Erie, rich soils, sand and gravel, and ceramic clay. The present day wild life and plants are indicators of soil conditions and weather patterns that have been evolving since the last ice disappeared. Swampy forests and lakes have relic plant communities, representing one of the older stages. Lake levels and moraines are described, the latter shown on a sketch map.—E.S.L.

8115 **Schieltz, N. C.; Soliman, M. R.** Thermodynamics of the various high temperature transformations of kaolinite, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 419–428, illus., tables, 1966.

Thermodynamic calculations of ΔG for all possible transformations of metakaolin at the temperature of the first DTA exothermic peak indicates that the most stable transformation is the one that yields mullite rather than γ-alumina. The energy of crystallization of γ-alumina is quite small—36,513 cal per mol, compared with the energy of crystallization of mullite—336,180 cal per mol. Furthermore, the crystallization of γ-alumina is very slow, and the crystal growth never produces crystallite sizes much larger than the lower end of the colloidal region. Hence, the gradual release of the small amounts of energy liberated during the crystallization

of γ alumina would be extremely difficult to detect by DTA methods.—Authors' abstract

8156 **Schnable, Jon.** Development of part of the northwest Florida coast: Coastal Research Notes, v. 2, no. 2, p. 13–14, 1966.

An investigation in the Apalachicola delta region indicates that Pleistocene and Recent sediments, thickening to the southwest, were deposited on an uneven Miocene surface. The thickest Pleistocene section, west of the river mouth, consists of two sequences representing a Sangamon and a mid-Wisconsin transgression of the sea. The thickest section of Recent sediments lies in an incised valley, cut during the last lowering of sea level, and it consists of deltaic, pro-deltaic, and bay sediments. Bays, barrier islands, spits, and an offshore basin, are the only other areas of significant Recent sedimentation. A relatively high stand of the sea, near present level, between 40,000 and 24,000 B.P. is suggested, and may correspond to the Silver Bluff. No evidence is found for a higher Recent stand, but a level 10–15 feet below present, between 4,500 and 4,000 B.P., is indicated.—E.S.L.

7919 **Schneider, Allan F.** Physiography, *in* Natural features of Indiana—Symposium, 1966 (Indiana Sesquicentennial Volume, 1816–1966): Indianapolis, Ind., Indiana Acad. Sci., p. 40–56, illus., 1966.

Indiana can be divided into three broad physiographic zones that trend generally east-west. The central zone, about 12,000 sq mi of low relief, underlain by thick glacial till only slightly eroded by postglacial streams, is called Tipton Till Plain. The Northern Moraine and Lake Region of 8,500 sq mi, divided into five physiographic units, has a great variety of depositional forms, mostly of glacial origin. Landforms of southern Indiana are largely the result of normal degradational processes—the unglaciated middle part reflecting bedrock structure, stratigraphy, and lithology and glaciated lateral parts with drift so thin that physiography is bedrock controlled. Seven physiographic units are recognized in this 15,500 sq mi southern zone, all of which trend north-northwest with the strike of the bedrock formations.—G.D.C.

7833 **Schneider, George J.; Winkler, Erhard M.** Light transmission through marble [abs.]: Indiana Acad. Sci. Proc. 1965, v. 75, p. 149, 1966.

8135 **Schoen, Robert; White, Donald E.** Hydrothermal clay minerals in granodiorite of the Main Terrace, Steamboat Springs, Nevada [abs.], *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 121–122, 1966.

8099 **Schopf, J. M.** Definitions of peat and coal and of graphite that terminates the coal series (graphocite): Jour. Geology, v. 74, no. 5, pt. 1, p. 584–592, 1966.

A new definition of peat is proposed that is coordinate with a previously published definition of coal (Schopf, 1956). "Peat is an unconsolidated, hydrophilic, carbonaceous sediment, formed by accumulation of partially fragmented and decomposed, more or less altered, and commonly heterogeneous plant remains, which retains more than 75 percent non-phreatic moisture and less than 12 percent mineral matter in saturated natural deposits. Peat deposits are protected from dissipation by persistent moisture relationships and, in certain geologic situations, may be buried, consolidated, and form coal." Graphocite is the end product of coal metamorphism which largely corresponds with meta-anthracite, but differs by being more than 50 percent graphitic carbon.—V.E.S.

7923 **Schryver, Kees.** Geology of Houde-Masson area, Berthier and Maskinongé counties [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 531, 16 p., table, geol. map, 1966.

This Precambrian area, 80 miles north of Montreal, is in the Grenville province of the Canadian Shield; the most abundant rock units are variable amphibole biotite-pyroxene (-garnet) gneisses. Gradations from one rock type to another, and between tabulated lithologic units are common in the first four units; sharp

boundaries mark most of the other five. In the northeast quadrant is a small body of gabbro, grading into amphibolite; fine-grained gray dikes occur in the augen gneiss-leuconorite and vicinity. Direct and chemical evidence, mineral types and associations, and structural fabric indicate the origin and history of the rocks. No major folds or faults were found. Heavy mineral aggregates occur along contacts of leuconorite and augen gneiss. Results of geochemical analyses of stream sediments are given on the geologic map.—G.D.C.

7925 **Schryver, Kees.** Geology of Saint-Michel-des-Saints (West) area, Joliette, Berthier and Maskinongé counties [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 552, 13 p., table, geol. map, 1966.

In this area in the Laurentian Uplands part of the Grenville province of the Canadian Shield the rocks, all Precambrian, are classified as of sedimentary, unknown, and igneous origins. The oldest unit consists of biotite-garnet gneisses with undoubted sedimentary interlayers; only carbonate bodies are large enough to be shown on the map. Unit 2 is mainly feldspar-quartz gneisses, interlayered with darker rocks; distinction between the two units is equivocal, gradational boundaries approximate. A southern, presumably igneous complex of deformed and recrystallized rocks with definite contacts, outlined in units 3 to 6 as orthogneisses, has inclusions of older paragneisses and common gneisses. The parallelism of foliation planes and lithologic contacts is reflected in drainage patterns. Mineral associations and fabric of rock types indicate regional metamorphism of the amphibole-granulite facies.—G.D.C.

8022 **Schuiling, Roelof D.** Tin-belts around the Atlantic Ocean and continental drift [abs.]: Econ. Geology, v. 61, no. 7, p. 1300, 1966.

8128 **Schultz, Leonard G.** Lithium and potassium absorption, differential thermal, and infrared properties of some montmorillonites [abs.], *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 275, table, 1966.

8071 **Schwarcz, Henry P.** Oxygen isotope fractionation between host and exsolved phases in perthite: Geol. Soc. America Bull., v. 77, no. 8, p. 879-882, tables, 1966.

Oxygen isotope analyses of three granitic perthites show no significant differences between host microcline and exsolved plagioclase.—A.G.

Scoon, J. H. *See* Muir, I. D. 8095

Scott, A. D. *See* Smith, S. J. 7883

8126 **Scott, A. D.; Reed, M. G.** Expansion of potassium-depleted muscovite, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 247-261, illus., table, 1966.

K-depletion of muscovite with NaCl-NaTPB solutions did not change the layer charge, but the basal spacing increased from 10 to 12.3 A. In the larger size fraction, the particles retained an inner core of 10 A, as the weathered fringe increased. There was no interstratification. In the finer fraction, mixed-layer structures developed as K was removed.—E.S.L.

Scott, S. D. *See* Barnes, Hubert L. 8019

Seidel, Don C. *See* Fitzhugh, Edward F., Jr. 8023

8236 **Selig, Franz; Wermund, E. G.** Families of salt domes in the Gulf Coastal Province: Geophysics, v. 31, no. 4, p. 726-740, illus., tables, 1966.

The theory of Rayleigh-Taylor instability is used to study the distribution of salt domes in the Gulf Coastal Province. The model shows that (1) the spacing of salt domes about an initial disturbance depends on mother salt thickness and viscosity ratio of overlying sediment to salt; (2) domes not only grow upward from the initial

disturbance, but are also triggered in the vicinity of the primary disturbance, forming a family of incipient domes with regular pattern; (3) the family of incipient domes develops out of the initial disturbance starting at the location of maximum instability and spreading radially. Several numerical examples provide a framework for examining the disturbance of Gulf Coast salt domes.—D.B.V.

8225 **Semken, Holmes A., Jr.** Stratigraphy and paleontology of the McPherson *Equus* beds (Sandahl local fauna), McPherson County, Kansas: Michigan Univ. Mus. Paleontology Contr., v. 20, no. 6, p. 121–178, illus., tables, 1966.

Pleistocene rocks collectively designated McPherson *Equus* beds in the past are here divided into the Kansan Meade Group, including the Pearlette Ash Member, and the Illinoian McPherson (redefined) and Loveland Formations of the Sanborn Group. Fluvial re-entrenchment during late Wisconsin time allowed deposition of topographically low terrace deposits. Most fossil vertebrates recovered have been from the McPherson Formation as redefined. A micro-vertebrate fauna, consisting largely of mammal teeth, is here designated the Sandahl local fauna. Paleoecological interpretations based on extant species suggest a glacial rather than interglacial deposition for the McPherson. All fossil rodents and insectivores from the Sandahl have been recovered also from other Illinoian deposits.—*from* Author's abstract

Serkies, J. *See* Letowski, F. 8001

Shappirio, Joel R. *See* Heinrich, E. William. 7946

8264 **Sharp, A. J.** Some aspects of Mexican phytogeography [with Spanish summ.]: Ciencia, v. 24, nos. 5–6, p. 229–232, 1966.

Most groups of plants in the Mexican flora have taxa with distribution patterns which indicate that there is a strong Asiatic element, perhaps best represented in the Bryophytes. Paleobotanical evidence indicates that certain genera may have migrated from Asia or Asia and North America to Mexico in pre-Pleistocene times where the great multiplicity of microenvironments permitted survival.—Author's summary.

7985 **Sharp, Robert P.** Kelso Dunes, Mojave Desert, California: Geol. Soc. America Bull., v. 77, no. 10, p. 1045–1073, illus., tables, 1966.

Fifteen years of measurement across individual transverse dunes have established a high degree of activity but only slight net sand movement. Crestal position is not a reliable index of bulk movement. Lee slope beds with 10–25° dip predominate but only modestly reflect prevailing western winds. Orographic controls greatly complicate the picture. Smoke pot studies show no strong fixed eddy currents lee of dunes, and strong transverse winds produce little sand movement. Eolian size distribution and sorting characteristics are well established in 10–12 miles of saltation transport with further transport producing further rounding and more mineralogical fractionation.—J.J.H.

Shaw, A. B. *See* Creath, W. G. 8230

8253 **Shaw, Alan B.** Paleontology of northwestern Vermont—[Pt.] 12, Fossils from the Ordovician Highgate Formation: Jour. Paleontology, v. 40, no. 6, p. 1312–1330, illus., 1966.

Species from the Highgate Formation of northwestern Vermont and the related Beekmantown Group of Quebec are treated. Sixteen named and 3 unnamed species are described: *Diplozyga rossi* (Valmy Formation, Nevada) and *"Plumulites" clarki* are new. Thirteen generic names are used; *Typhlokorynetes* (based on *Warburgella plana* Raymond) and *Marcouella* (based on *Lloydia pinguis* Bradley) are new. The former is assigned to the new family Typhlokorynetidae, and the latter to the new subfamily Leiostegiinae. *Metoptogyrus* Raymond is considered synonymous with *Niobella* Reed. *Strototropis and Leiostrototropis*, both of Raymond, are considered synonymous with *Protopliomerops* Kobayashi.—R.E.G.

8048 **Shea, F. S.** Lower Carboniferous stratigraphy of the Windsor–Horton district of Nova Scotia [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 99–106, illus., 1966.

The lithology and formational relationships of the Mississippian Horton and Windsor Groups, unconformably overlying lower Paleozoic strata, are described. The marine Windsor Group disconformably overlies the nonmarine Horton. Outliers of the Triassic Wolfville Formation overlie the Mississippian with angular unconformity along the south shore of Minas Basin. Geologic sketch maps of the Walton and Cheverie areas are included.—E.S.L.

Sheldon, R. P. *See* Ziegler, A. M. 7860

Shimizu, K. *See* Andrews, J. T. 7991

Shimp, N. F. *See* Graf, D. L. 8218

7974 **Shirozu, Haruo; Bailey, S. W.** Crystal structure of a two-layer Mg-vermiculite: Am. Mineralogist, v. 51, no. 7, p. 1124–1143, illus., tables, 1966.

Refinement of a normal 14.3A phase shows that the structure has stacking sequence *s* with the talc tetrahedral network distorted by rotations of the tetrahedra towards the nearest interlayer water molecules. One of the three available interlayer cation sites is statistically occupied by magnesium, and the water molecules are randomly distributed over the three sets of possible positions. The genesis of the observed ordering of silicon and aluminum in the tetrahedra of vermiculite remains in doubt.—J.R.C.

7914 **Shklanka, R.** Bee Lake area, Kenora District: Ontario Dept. Mines Map 2097, scale 1:31,680, 1966.

Silver, Leon T. *See* Banks, Philip O. 8231

Silverman, S. R. *See* Spotts, J. H. 7975

7876 **Simon, Wilhelm.** Präkambrische Petrefakten und das Alter der ältesten Lebewesen: Aufschluss, v. 17, nos. 7–8, p. 171–178, illus., 1966.

Among the oldest signs of life from various parts of the world compared here are multicellular plant remains from the Precambrian Belt Series of western United States and Canada, about a billion years old; multicellular and unicellular plants of microscopic size from the Gunflint Series of Ontario, about two billion years old; and other North American fossil forms of Precambrian and early Cambrian age, such as brachiopods, algae, and arthropod Xenusion. Three old ages are designated: 550 million years; 1100 million years; and 1100 to 2000 million years. Other signs of possible life have been wiped out by metamorphism of rocks or deeply buried in the Earth's strata.—G.D.C.

8214 **Sinkankas, John; Ried, Arch M.** Colour-composition relationship in spessartine from Amelia, Virginia: Jour. Gemmology, v. 10, no. 4, p. 125–134, illus., tables, 1966.

In the garnet group, miscibility among end-members makes it difficult to draw conclusions as to composition, because property values extend over a wide range, and colors, especially in the pyralspite group, grade imperceptibly into one another. No natural end-members of this group have been reported, although analyses indicate combinations of three or more. Color may be useful in narrowing compositional possibilities, and a table of hues of natural pyralspite garnets according to the principal end-member is given. Spessartites from Amelia, Va., indicate that the brown to orange tinge is characteristic. The color-graded spessartites were analyzed with an electron probe, which showed that the colors reflect the ratio MnO-(FeO,CaO). Refractive index results show the same variation.—E.S.L.

8016 **Skinner, Brian J.** Quenching properties—Their limitation on the use of sulfides as geologic thermometers [abs.]: Econ. Geology, v. 61, no. 7, p. 1295–1296, 1966.

Skinner, Brian J. *See* Barton, Paul B., Jr. 8017

8141 **Skvarla, John J.** Techniques of pollen and spore electron microscopy—Pt. 1, Staining, dehydration, and embedding: Oklahoma Geology Notes, v. 26, no. 7, p. 179–186, illus., table, 1966.

Procedures to be followed in preparation of spores and pollen for ultramicrotomy from time of acetolysis through embeddment in resins are described. The osmium tetroxide treatment is optional but helps to make a more consistent electron microscope image. Uranyl acetate staining follows, after which exines may be concentrated into pellets by agar embedding or processed in an unconcentrated state. Advantages of the former method are that numerous exines can be sectioned at one time and various orientations obtained; the latter has the advantage of more effective filtration by embedding resins and is less susceptible to thin-sectioning difficulties. Dehydration of agar-exine cubes is accomplished by passage through a graded series of alcohols. Steps in embedding in Araldite-Epon, which gives best results, are described in detail. An appendix on preparation of aluminum embedding trays from household aluminum foil is included.—B.S.H.

8113 **Sloane, Richard L.** Early reaction determination in two hydroxide-kaolinite systems by electron microscopy and diffraction, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 331–339, illus., table, 1966.

Results of study of kaolinite-sodium hydroxide interaction showed extensive dissolution of kaolinite structure at particle edges, with some production of "silicate relicts", and study of kaolinite-calcium hydroxide interaction formation of an insoluble reaction product, tentatively identified as prehnite. Both studies showed an ephemeral phase that, by selected area electron diffraction, appeared to be a layer lattice silicate in (001) orientation. In calcium hydroxide-treated kaolinite, formation of the reaction product was followed from nucleation along particle edges, after 24 hr, to growth of particles about 0.5 to 1 μ in size after 15 days. Combination of electron microscopy of surface replicas to detect changes in morphology with selected area electron diffraction of parallel pseudoreplicas for identification shows promise as a tool for study of early stages in mineral-chemical interaction.—*from* Author's abstract

Smith, C. W. *See* Philbin, P. W. 7863

Smith, C. W. *See* Philbin, P. W. 7864

Smith, C. W. *See* Philbin, P. W. 7865

Smith, C. W. *See* Philbin, P. W. 7866

Smith, C. W. *See* Philbin, P. W. 7867

Smith, C. W. *See* Philbin, P. W. 7868

Smith, D. K. *See* Kahn, J. S. 7977

7787 **Smith, Donald Leigh.** The Tippecanoe Sequence in western North America [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 521B, 1966.

7888 **Smith, H. W.; Moodie, C. D.; Okazaki, R.; Ellsworth, N.** Hydrolysis and salt-retention errors in conventional cation exchange-capacity procedures, [Pt.] 2: Soil Sci., v. 102, no. 2, p. 94–106, illus., 1966.

Errors in cation exchange-capacity procedures can be studied successfully only if reliable reference data can be established. Three errors are common to procedures

with a washing step to remove the remaining saturating salts. These are sample dispersion and loss, index-cation hydrolysis, and salt retention.—J.W.H.

8038 **Smith, J. C.** Geology of southwestern New Brunswick [with French abs.], *in* Geology of parts of Atlantic Provinces—Geol. Assoc. Canada and Mineralog. Assoc. Canada, Guidebook, 1966: Halifax, Nova Scotia [Nova Scotia Dept. Mines], p. 1–12, illus., 1966.

The rocks of the area range in age from Precambrian to Triassic, and have a complex history involving several periods of deformation and intrusion. A correlation chart is included. Maximum effects of the Acadian orogeny occurred in mid-Devonian, and the boundary limiting effects of the Appalachian orogeny appears to lie between the Bay of Fundy and the Central basin. Small occurrences of metals are reviewed.—E.S.L.

8258 **Smith, J. T.; Montgomery, J. H.; Blakey, J. F.** Base-flow studies, Little Cypress Creek, Upshur, Gregg, and Harrison Counties, Texas—Quantity and quality, January and June 1964: Texas Water Devel. Board Rept. 25, 23 p., illus., tables, 1966.

Total drainage area of Little Cypress Creek, a typical old-age stream, is 693 sq mi. It crosses the East Texas Embayment, and outcropping beds are all in the Tertiary Claiborne and Wilcox Groups. The Kelsey anticline affects the configuration of Kelsey and Little Cypress Creeks. The geologic units function as a single aquifer, the Cypress, in which the Queen City Sand is found to be the main source of ground water and base flow within the watershed. Much of the precipitation is absorbed by the exposed sand and is discharged in springs and seeps farther down the slope. During periods of low flow the streamflow in the creek is sustained by ground-water effluent. Water discharge and chemical character are shown in tables and graphs, and a map accompanying the paper.—E.S.L.

7932 **Smith, James Mitchell.** Ohio landscape puzzle: Indiana Acad. Sci. Proc. 1965, v. 75, p. 202–205, 1966.

South of Reily, Ohio, an oddly shaped hill occupies the southern portion of the broad valley of Indian Creek. The core is a cone of Ordovician limestone, like that outcropping on the uplands. The hill is separated from the uplands by bottom land which has not served as a bed of the creek, and it is proposed that the separation occurred by glacial removal of bedrock and till, and that a stream ran on top of the glacier occupying the valley and depositing fine sand on its bed. The sand on top of the hill represents part of this bed.—E.S.L.

7936 **Smith, James Mitchell.** Earth science in secondary schools [abs.]: Indiana Acad. Sci. Proc. 1965, v. 75, p. 246, 1966.

Smith, Jordan R. *See* Lawson, Don E. 8259

Smith, R. N. *See* Davies, J. L. 8041

8085 **Smith, R. W.; Wen, W. W.** Adsorption of cationic and anionic surfactants on kaolinite, *in* Mining Symposium, 27th Ann., and AIME, Minnesota Sec., 39th Ann. Mtg., Duluth, 1966: Minneapolis, Minn., Univ. Minnesota, Nolte Center Continuing Education, p. 193–196, illus., 1966.

Kaolinite of high grade from Lewistown, Mont., was obtained for adsorption tests. It was found that both anionic and cationic surfactants appear to adsorb strongly on kaolinite. Cationic adsorption increases with increasing pH, surfactant concentration being limited by the cation exchange of the clay; for the clay studied the maximum appears to be 3 mequiv/100 gm kaolinite at an equilibrium pH 9.5. Anionic surfactant adsorption increases with decreasing pH although there were discrepancies at near neutrality which may have resulted from heavy metal activation. The maximum anion exchange capacity for the kaolinite studied at low equilibrium pH values appears rather high, greater than 40 mequiv/100 gm clay; however the surfactant adsorption at near neutrality is much less than this.—G.D.C.

7883 **Smith, S. J.; Scott, A. D.** Extractable potassium in grundite illite—[Pt.] 1, Method of extraction: Soil Sci., v. 102, no. 2, p. 115–122, illus., 1966.

It is concluded that only a portion of the potassium in grundite illite is exchangeable with sodium and that this limited exchange is due to an inherent characteristic of the illite rather than the extracting solution. Also by comparing these results with previous observations that almost all of the potassium in muscovite is extractable, it is suggested that materials other than potassium are responsible for the limited extraction observed with grundite illite.—J.W.H.

8232 **Smith, Stanley T.; Dougherty, Elmer L.** Reply [to discussion by N. S. Neidell of "The use of linear programming to filter digitized map data", 1966]: Geophysics, v. 31, no. 4, p. 829, 1966.

In reply to Neidell's comments (ibid., v. 31, no. 4, p. 828–829, 1966), Smith and Dougherty point out that the L_1 Norm was used because it provides a better fit to the data when wild points exist, and because a wild point is easily detected by the magnitude of its residual. Their procedure is used prior to attempting to fit a surface to the data in order to interpolate them to a uniform grid.—D.B.V.

8057 **Smith, W. Everett.** Mineralogical notes of some rocks of the Talladega Series [abs.]: Alabama Acad. Sci. Jour., v. 37, no. 3, p. 261–262, 1966.

7886 **Smith, W. O.; Olsen, H. W.; Bagnold, R. A.; Rice, J. C.** Certain flows of air and water in sands during infiltration: Soil Sci., v. 101, no. 6, p. 441–449, illus., table, 1966.

During ordinary infiltration of water into uniform sand, air is transported by moving water. Previous studies have shown that such air may consist of piston flows, that is, bulk air displaced ahead of a wetting front. This investigation shows that it may consist also of entrapped air, that is, air picked up by a capillary process from the bulk air encountered at the front of an infiltrating water mass.—J.W.H.

7772 **Soister, Paul E.** Puddle Springs Arkose Member of Wind River Formation, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244–A, p. A42–A46, 1966.

Soliman, M. R. *See* Schieltz, N. C. 8115

Sousa, Theresa M. *See* Fischer, William A. 8074

7818 **Speden, Ian Gordon.** Paleozoology of Lamellibranchia from the type area of Fox Hills Formation (Upper Cretaceous, Maestrichtian), South Dakota [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 521B–522B, 1966.

7975 **Spotts, J. H.; Silverman, S. R.** Organic dolomite from Point Fermin, California: Am. Mineralogist, v. 51, no. 7, p. 1144–1155, illus., tables, 1966.

Petrography and stable carbon isotope data indicate that small dolomite rhombohedra that occur with tar as cement in some California Miocene sands were partially derived from the alteration of the tar or other organic matter. The dolomite cement occurs in blue-schist turbidite sandstones that are exposed in sea cliffs at Point Fermin, Los Angeles County, Calif. The euhedral crystals are attached to sand grains and are also apparently embedded in the tar cement. The dolomite crystals have several types of nuclei: (1) rhombohedral to spherical tar globules similar to the tar surrounding the euhedra, (2) gaseous bubbles, and (3) combinations of these. . . .—Authors' abstract

8097 **Sriramadas, Alura.** Geology of the Manchester quadrangle, New Hampshire: New Hampshire Dept. Resources and Econ. Devel. Bull. 2, 78 p., illus., tables, geol. map, 1966.

Bedrock consists chiefly of schists, granulites, and gneisses of probable Silurian and Devonian age, granitic rocks and pegmatites of probable Devonian age, and diabase dikes possibly as young as Triassic. Most bedrock belongs to the Silurian(?)

Merrimack Group composed of the Eliot and Berwick Formations and totaling about 17,500 feet. The Devonian Littleton Formation, in two small areas in the central part, consists chiefly of mica schist. The northwest corner of the quadrangle is underlain by Massabesic gneiss, altered from the Berwick Formation. Plutonic rocks range from granite to gabbro. The structure is a major syncline with superimposed minor folds. Mineralogical studies were carried out on feldspars, amphiboles, biotites, and garnets. The rocks were regionally metamorphosed during the Acadian orogeny, and injected by granitic material.—E.S.L.

8245 **Stephan, Joachim G.** Mapping the ocean floor: Battelle Tech. Rev., v. 15, nos. 7–8, p. 7–11, illus., 1966.

Unconventional photogrammetric procedures are described that may be feasible for mapping the ocean floor. Based upon side-looking sonar, the procedures promise a speedier means for undersea reconnoitering and mapping than are currently available. One SLS image illustrated shows a half-mile-wide section of the ocean bottom at a depth of over 8,000 feet; another, of a section of the Hudson River, is compared with a Coast and Geodetic chart.—G.D.C.

7817 **Stephenson, David Arthur.** Hydrogeology of glacial deposits associated with the buried Mahomet Bedrock Valley of east-central Illinois [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 522B, 1966.

Stephenson, Neville C. *See* Papike, J. J. 7970

Stern, T. W. *See* Pearson, Robert C. 7987

7988 **Stevens, Calvin H.** Paleoecologic implications of early Permian fossil communities in eastern Nevada and western Utah: Geol. Soc. America Bull., v. 77, no. 10, p. 1121–1129, 1966.

Eight major marine and paralic fossil communities are recognized in rocks of early Permian age in eastern Nevada and western Utah. The communities, named for characteristic faunal elements, are palaeotextulariid, fusulinid, coral, dictyoclostid–*Composita*, chonetoid, *Heteralosia*, nuculanid, and euphemitid. Distribution of the communities apparently was controlled chiefly by salinity, depth, and wave or current action, and turbidity was generally of secondary importance.—D.H.W.

7771 **Stewart, John H.; Barnes, Harley.** Precambrian and Lower Cambrian formations in the Desert Range, Clark County, Nevada, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244-A, p. A35–A42, illus., 1966.

Stokes, William Lee. *See* Utah Geological Society, 7827

7806 **Stone, John E.** Surficial geology of the New Brighton quadrangle, Minnesota: Minnesota Geol. Survey Geol. Map Ser. GM-2, scale 1:24,000, separate text, 1966.

The New Brighton quadrangle is underlain by up to 500 feet of glacial drift, lying directly on Paleozoic sedimentary rocks. Bedrock, part of the northern flank of the Twin Cities artesian basin, is traversed by a complex network of buried valleys (to 400 feet deep) cut during several cycles of erosion. Most of the surface morphology and related deposits were formed about 12,500 years ago, during advance and retreat of the Grantsburg Sublobe. After active ice retreat, the West Campus Sand was deposited; later hundreds of kettle holes formed, the valley train was dissected, and a poorly integrated drainage system was produced. In late- and post-glacial time, thin deposits of eolian sand, loess, and colluvium were laid down. Preliminary data are given on engineering properties of surficial deposits.—*from* Author's abstract

Strimple, Harrell L. *See* Kesling, Robert V. 7832

Strimple, Harrell L. *See* Kesling, Robert V. 7856

Struve, Wolfgang. *See* Boucot, A. J. 8171

7845 **Sumner, M. E.; Marques, J. M.** Ionic equilibria in a ferrallitic clay—Specific adsorption sites for potassium: Soil Sci., v. 102, no. 3, p. 187–192, illus., 1966.

The exchangeable potassium in a K–Ca ferrallitic (ultisol) clay was measured. The potassium adsorption can be accounted for by the presence of a small amount of montmorillonite in the predominantly kaolinitic clay fraction. The potassium deficiency in ferrallitic soils may be due to the hexagonal holes in the tetrahedral layer of the montmorillonite and to the fact that kaolinite does not seem to play a role in ion fixation.—J.W.H.

Swanson, Vernon E. *See* Ong, H. Ling. 8002

Swift, Donald J. P. *See* Borns, Harold W., Jr. 8046

8112 **Swoboda, A. R.; Kunze, G. W.** Infrared study of pyridine adsorbed on montmorillonite surfaces, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 277–288, illus., table, 1966.

The nature of pyridine adsorption by acid- and base-saturated montmorillonite from Otay, Calif. (A.P.I. no. H-24) was studied by infrared adsorption. The spectrum for chemisorbed pyridine was found to be distinctively different from physically adsorbed; the latter gave a spectrum very similar to liquid pyridine. Upon exposure of the clay films to pyridine at low vapor pressures, only the pyridinium ion spectrum was obtained; but when the vapor pressure was increased, both chemisorbed and physically adsorbed pyridine was detected. The intensity of the spectrum for physically adsorbed molecules could be reduced by a vacuum, whereas those for the chemisorbed pyridinium ions were unaffected. Interlayer water was replaced by adsorption of pyridine. Water, in turn, replaced physically adsorbed pyridine from the clay surface but was unable to replace chemisorbed.—*from* Authors' abstract

8224 **Tackett, Stanford L.; Mayer, Wallace M.; Pany, Frank G.; Moore, Carleton B.** Electrolytic dissolution of iron meteorites: Science, v. 153, no. 3738, p. 877–880, illus., 1966.

When iron meteorites are dissolved anodically in neutral solution, nonmetallic inclusions are not attached and collect at the bottom of the anode compartment. When the meteorites contain both kamacite and taenite, the kamacite dissolves preferentially, revealing a three-dimensional Widmanstätten pattern.—Authors' abstract

Take, W. F. *See* MacNeill, R. H. 8044

8106 **Takéuchi, Y.** Structures of brittle micas, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 1–25, illus., tables, 1966.

A 1M structure for xanthophyllite and a $2M_1$ for margarite have been refined by three-dimensional least squares. Ordering of Mg and Al has been observed in the octahedral layers of xanthophyllite, but no significant evidence for ordering among cations in margarite. The tetrahedral layers of xanthophyllite show the highest deformation observed in layer silicates, caused by rotations of tetrahedra around an axis perpendicular to (001). The tetrahedra are rotated about 23° in xanthophyllite, and 21° in margarite. The configuration of the octahedral layers in margarite has the same features as those in muscovite and dickite. An index, D, has been defined that is a direct measure of the misfit between octahedral and tetrahedral layers, and by which the layer silicates may be classified into three categories.—E.S.L.

8163 **Tappan, Helen.** Chitinozoan classification: Jour. Paleontology, v. 40, no. 6, p. 1394–1396, 1966.

A list of families, genera, and synonyms of Chitinozoa, is given. The families Conochitinidae and Desmochitinidae, are recognized as emended by Taugourdeau (1966), as is his new family Ancryochitinidae. The family Lagenochitinidae is restricted from Taugourdeau's emendation, and the family Hoegisphaeridae is reinstated.—J.F.M.

Tatsumoto, M. *See* Rosholt, J. N. 7871

8337 **Taylor, D. W.** Summary of North American Blancan nonmarine mollusks [with Spanish and Russian abs.]: Malacologia, v. 4, no. 1, p. 1–172, illus., tables, 1966.

All known North American nonmarine mollusks of Blancan (late Pliocene) and early Pleistocene) age have been fitted into a framework of associated fossils, physical stratigraphy, and absolute ages. Lists of last appearances are given. About 50–55 assemblages are known, and with about 10–15 older or younger faunas, are summarized under local geographic headings from the Great Plains and western United States. Faunas from the Great Plains are generally similar and include mainly widespread living species, while those from the western states are different from one another, and from living fauna. The living molluscan fauna east and west of the divide also shows contrasts. A catalog of mollusks described from Blancan types, and sections of taxonomic notes and changes are included.—E.S.L.

Taylor, R. E. *See* Berger, Rainer. 8250

7945 **Temple, A. K.** Zoisite–rutile rock from Los Angeles County, California: Am. Mineralogist, v. 51, no. 7, p. 1028–1034, illus., table, 1966.

Small scattered pods of zoisite–rutile rock occur within one of two belts of en-echelon lenticular serpentinite bodies. The serpentinite is largely altered to a talcose rock and the bodies are rimmed by coarse-grained actinolite. The zoisite–rutile rocks are gradationally rimmed by a zoisite–sphene–serpentine assemblage, in turn grading out to a black serpentine rock with disseminated ilmenite. A country rock inclusion is also rimmed by a zoisite–talc–garnet assemblage. It is postulated that the zoisite–rutile assemblage formed within the serpentinite by metasomatic transfer of material derived from the alteration of the serpentinite and controlled by pressure differential within the serpentinite body.—Author's abstract

8077 **Temple, A. K.** The Midway–Wilcox boundary in Kemper and Lauderdale Counties, Mississippi: Southeastern Geology, v. 7, no. 3, p. 121–129, illus., tables, 1966.

Subsurface information in Kemper and Lauderdale Counties, Miss., confirms the presence of a persistent lignite layer at the base of coarse sands of the Wilcox Group that overlie fine micaceous sands of the Kemper Member of the Naheola Formation. The Kemper Member thins to the north, and in northern Kemper County, the Wilcox coarse sand rests directly on the Porters Creek Formation without any intervening lignite or Naheola Formation. The northern limit of the lignite represents an early Wilcox shoreline that is marked by fluviatile Wilcox gravels occupying channels in the Porters Creek clay. The lignite is interpreted as the actual line of sea level retreat with the lignite being a swamp deposit laid down behind the retreating shoreline.—Author's abstract

Terlecky, P. Michael. *See* Pilkey, Orrin H. 7952

8131 **Tettenhorst, Rodney; Johns, W. D.** Interstratification in montmorillonite, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 85–93, illus., tables, 1966.

Direct analysis by Fourier transform methods revealed interstratification of three components for a homogeneous, potassium-treated and organic-solvated montmorillonite. An initial simple interpretation based on random mixing of two

components was shown to be incorrect. Ethylene glycol solvation showed enhanced expansion in agreement with earlier investigations. Glycerol solvation produced a noteworthy contribution from a 14 A component. An interpretation of the 14 A component is suggested, based on an asymmetric distribution of layer charge. Regular interstratification, bending or curling of clay layers and anomalous dehydroxylation temperatures may be a consequence of asymmetric layer charge distribution in montmorillonites.—Authors' abstract

Thayer, T. P. *See* Brown, C. Ervin. 7766

Thayer, T. P. *See* Brown, C. Ervin. 7768

7769 **Thayer, T. P.; Brown, C. Ervin.** Columbia River Group, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244-A, p. A23-A25, illus., 1966.

Thomas, H. H. *See* Pearson, Robert C. 7987

Thompson, K. C. *See* Cohenour, R. E. 7830

Tieh, Thomas T. *See* Parks, George A. 7807

Tilley, C. E. *See* Muir, I. D. 8095

Tilson, Seymour. *See* Leopold, Luna B. 8246

8122 **Tobias, T. J.; Ruotsala, A. P.** Long-term settling characteristics of some clays, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 395-398, illus., table, 1966.

Suspensions of approximately 8 g per l were prepared using Georgia kaolin, Mississippi bentonite, Wyoming bentonite, Iowa illite and finely ground quartz. In addition, 2 g and 16 g per l suspensions of kaolinite were prepared. All suspensions were observed for 2-week periods at 19°C; kaolinite suspensions were also observed at 2°, 10°, 25°, and 31°C. After 3-4 days at 19°C, layering formed in all clay suspensions. At 20°C, no stratification developed in the kaolinite suspensions. The experiments showed that temperature and concentration markedly affect long-term settling characteristics of fine-grained suspensions. Layering forms most readily in water with relatively low viscosity and density. In nature, such features as graded bedding, lamination, or varving probably would result after complete settling.—*from* Authors' abstract

8228 **Toomey, D. F.; Klement, K. W.** A problematical micro-organism from the El Paso Group (Lower Ordovician) of West Texas: Jour. Paleontology, v. 40, no. 6, p. 1304-1311, illus., 1966.

This problematical form is a straight to slightly curved tubular micro-organism that has a conspicuous dark central canal and a distinctive radial-hyaline wall structure. The wall is usually single-layered, but multilayered walled forms are also known. The micro-organism has previously been described as *Nuia siberica* Maslov, 1954, from Lower Ordovician rocks of Siberia. Subsequent Russian writers have reported *Nuia* from additional Lower Ordovician localities in Siberia and Kazakhstan. They consider *Nuia* to be an alga, although they do not agree on the major algal group to which it should be assigned. The present writers review the arguments and conclude that it should be considered as a problematical micro-organism. The peculiarities of the internal structures do not permit its assignment to one of the established groups of fossil algae.—*from* Authors' abstract

8020 **Toulmin, Priestley, 3d; Barton, Paul B., Jr.** Significance of the FeS content of sphalerite as a geothermometer [abs.]: Econ. Geology, v. 61, no. 7, p. 1298, 1966.

8123 **Tressler, Richard E.; Williamson, William O.** Particle arrangements and differential imbibitional swelling in deformed or deposited kaolinite-illite clay, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th,

Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 399–410, illus., tables, 1966.

A fine-grained kaolinite-illite clay, in which planar particle orientation resulted from filtration or plastic deformation, swelled differentially when water was imbibed by test pieces already in the plastic state. Swelling was greater perpendicular than parallel to the plane in which the clay platelets tended to be arranged. Filtration, in contrast to deformation, gave test pieces that swelled more rapidly and extensively. The slipbands present in plastically deformed test pieces restricted the swelling. They were arranged diagonally to the plane in which the clay platelets tended to lie. The plastically deformed test pieces showed enhanced expansion perpendicular to this plane when they were made successively thinner by compression under a roller. This was attributed to improved planar orientation of the platelets.—Authors' abstract

Turner, Francis J. *See* Fyfe, W. S. 7793

7920 **Ulrich, H. P.** Soils, *in* Natural features of Indiana—Symposium, 1966 (Indiana Sesquicentennial Volume, 1816–1966): Indianapolis, Ind., Indiana Acad. Sci., p. 57–90, illus., 1966.

In this paper a brief description is given of the principal kinds of soils, their identification, and classification. A transect from east to west across southern Indiana shows the more striking regional differences in soils, geology, and physiography as well as the marked difference in age and characteristics of the younger and older soils. Soils in the rest of the State are discussed alphabetically by soil regions.—G.D.C.

8234 **Unklesbay, A. G.; Pauken, Robert.** Pennsylvanian ammonoids from Alaska: Jour. Paleontology, v. 40, no. 6, p. 1379–1380, illus., 1966.

A new species of *Pseudoparalegoceras* Miller from the Rainbow Mountain Sequence in the Alaskan Range indicates that these beds are Early Pennsylvanian in age. This species is similar to those from the Atokan Formation, Magdalena Limestone, and Bashkirian beds, all of Early Pennsylvanian age.—Authors' abstract

8078 **U.S. Army Engineers.** (District St. Louis). Geology, soils, and materials, App. D *in* Meramec River, Missouri–Comprehensive basin study, V. 4: St. Louis, Mo., U.S. Army Corps Engineers, p. D1–D45, illus., tables, 1966.

The report is divided into eight sections, which, including the introduction, cover physiography; general geology; geology of main-stream and tributary, and headwater reservoirs; soils investigations; and construction material availability. The basin was not glaciated, but has undergone several cycles of uplift and erosion. A thick mantle of solution residuum covers the bedrock. Areal geology of three sub-basins is given, including mineral resources. The stratigraphic succession ranges from Precambrian granite to Pennsylvanian; no Silurian or Devonian are present. The study includes ground-water occurrence by formations and geographic localities, faults and joint systems, engineering geology of seven main-stream and twelve tributary reservoir sites, logs of borings, and a cave tabulation.—E.S.L.

7950 **U.S. Library of Congress.** Bibliography on snow, ice and frozen ground, with abstracts: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. CRREL Rept. 12, v. 20, 342 p., 1966.

The bibliography covers basic and applied scientific research on snow, ice, and frozen ground, as well as living and working in polar regions and other cold areas. Each entry includes a bibliographic citation, code designating the library holding of the abstracted item, assigned call number, Universal Decimal Classification number, and the abstract.—M.C.M.

7827 **Utah Geological Society; Stokes, William Lee.** (editor). The Great Salt Lake: Utah Geol. Soc. Guidebook to Geology of Utah, no. 20, 173 p., illus., tables, 1966.

This guidebook contains ten papers. Seven cover the history, biology, geologic setting, sediments, chemistry, hydrology and climatology, and predecessors of Great Salt Lake; and three discuss Cenozoic structural basins, industrial development and potential of Great Salt Lake, and state rights to the beds of navigable lakes. Dissolved minerals of this lake amount to more than 5 billion tons in about these proportions: 77 percent sodium chloride, 9 percent sodium sulfate, 5 percent magnesium chloride, 4 percent magnesium sulfate, 4 percent potassium chloride, and 1 percent as compounds of lithium, bromine, and other elements.—H.D.G.

Utgaard, John. *See* Boardman, R. S. 8154

8110 **VandenHeuvel, Richard C.** The occurrence of sepiolite and attapulgite in the calcareous zone of a soil near Las Cruces, New Mexico, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 193–207, illus., tables, 1966.

Sepiolite and attapulgite were identified by X-ray diffraction, elemental and thermal analyses in the calcareous zone of a soil formed on a relict basin-fill plain in Dona Ana County. Sepiolite occurs in the lower part of the calcium carbonate accumulation zone, attapulgite above, in, and below the sepiolite zone. The sequence of dominant clay mineral with depth in the profile is montmorillonite, attapulgite, sepiolite, attapulgite, montmorillonite. No sepiolite or attapulgite was found above the calcareous zone. Thin sections showed sepiolite and attapulgite occurring as aggregates, as coatings on mineral grains, and as small fibers. Distribution and arrangement suggest that these minerals crystallized during the period of caliche formation. Sepiolite is present mainly in the nodular calcareous zone; attapulgite, mainly in the blocky calcareous zone and in the transition zone below the calcareous zone.—*from* Author's abstract

VanSchmus, W. Randall. *See* Dodd, Robert T., Jr. 7976

8179 **Vaughn, Peter Paul.** *Seymouria* from the lower Permian of southeastern Utah, and possible sexual dimorphism in that genus: Jour. Paleontology, v. 40, no. 3, p. 603–612, illus., 1966.

A new species of *Seymouria, S. sanjuanensis,* is described on the basis of specimens from the Lower Permian Organ Rock Shale, Cutler Group, San Juan County, Utah. T. E. White has noted that haemal arches begin farther back in the caudal column in the males; other possible dimorphic differences are that in males the interorbital breadth is less, the maxillary bone is deeper, and the dentition in general and the "canine" teeth in particular are more prominent. A specimen of *Seymouria* sp. from the Wichita Group of Texas indicates that two lines of *Seymouria*, one in the Four Corners area and one in the Midcontinent, may have evolved independently of one another after separation by a barrier to faunal exchange.—*from* Author's abstract

7947 **Vaz, J. E.; Zeller, E. J.** Thermoluminescence of calcite from high gamma radiation doses: Am. Mineralogist, v. 51, no. 7, p. 1156–1166, illus., 1966.

Three calcium carbonate samples were subjected to large total doses of both gamma and ultraviolet radiation. Each sample was also heated at different temperatures prior to the radiation treatment in order to observe the effects of heating. The peak intensity vs. dose curves of the thermoluminescence induced in the samples by gamma rays rise to a maximum at a total dose of about 3×10^6 Roentgens and may decrease beyond that point. Further evidence of trap depopulation is the sharp rise in peak temperature at total gamma-ray doses above 3×10^6R. A defect induced by the gamma radiation in the calcite crystal structure may be responsible for this effect. Glow-curves from samples illuminated with ultraviolet light are markedly less intense than for the gamma irradiated samples. These results suggest that retrapping may be a very important process in the thermoluminescence of calcite.—E.Z.

8144 **Velde, B.** Mixed-layer mineral associations in muscovite-celadonite and muscovite-chlorite joins [abs.], *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays

and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 29–32, illus., 1966.

8192 **Vernon, Peter; Hughes, O. L.** Surficial geology, Dawson, Larsen Creek, and Nash Creek map-areas, Yukon Territory (116B and 116C E1/2, 116A and 106D) [with French abs.]: Canada Geol. Survey Bull. 136, 25 p., illus., table, geol. maps, 1966.

Evidence for three glaciations is best observed near the valley of East Blackstone River in the western part of the area where the intermediate and last glaciations are marked by moraines. The oldest and most extensive glaciation is indicated by erratics outside the moraines. Moraines of the oldest glaciation have not been identified. In the western area glaciations were characterized by advances of valley glaciers originating in cirques along the axis of the southern Ogilvie Ranges. Ice flowed outward in the direction of modern drainage and extended only a short distance from the mountains leaving much of the Dawson map-area and Taiga Valley unglaciated. In the eastern part of the area the valleys were filled by a large transection glacier that flowed northwesterly and westerly from sources south of the map-areas. Surficial geologic maps of the three areas are included.—B.S.H.

7783 **Vian, Richard Wright.** Geology of the Devils Hole area, Fremont County, Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 522B–523B, 1966.

8138 **Vingas, George J.; Zrimsek, Arthur H.** Thermal stability of bentonites in foundry molding sand, *in* Clays and clay minerals [V. 13]—Natl. Conf. Clays and Clay Minerals, 13th, Madison, Wis., 1964, Proc.: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 25), p. 367–380, illus., tables, 1966.

The effects of heat on the behavior of sodium and calcium bentonite in bonding foundry sands were studied. Tests such as differential thermal analysis, viscosity, and melting or vitrification temperatures do not indicate the suitability of a bentonite for foundry use. The deterioration temperatures of Na- and Ca-bentonite are 1180° and 600°F respectively. Reactivities of bentonites with cereal as affected by temperature and mulling were also studied. Flowability of sands, defined as mold densification in this paper, is better with heated calcium than sodium bentonite. Heating bentonites alone does not simulate the conditions encountered in heating bentonite-sand mixtures in a mold.—Authors' abstract

7926 **Viveros Juarez, Manuel.** Exploración de bauxitas en la región de Guadalcázar y Villa Hidalgo, S.L.P.: Geología y Metalurgía, v. 2, no. 16, p. 20–25, illus., 1966.

Outcropping rocks in the area of Guadalcázar and Villa Hidalgo, S.L.P., consist of dense limestones. Faults are not notable except in places where rhyolitic intrusions have caused them. Limestones in mountain areas contain some cinnabar as veins, crusts, and filled fractures. Layers of crystalline gypsum with disseminated sulfur were also observed. Bauxite, for which the area was explored, is not present, and it is concluded that the area is not of economic interest.—E.S.L.

7816 **Volckmann, Richard Peter.** Geology of the Crestone Peak area, Sangre de Cristo Range, Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 523B, 1966.

Votaw, R. *See* Carr, D. D. 8244

7790 **Walker, Eugene H.** Significance of the scarcity of early Pleistocene glacial deposits in the western United States: Northwest Sci., v. 40, no. 3, p. 96–102, illus., 1966.

Evidence of glaciation in all four stages of the Pleistocene has been found in only three of the mountainous areas of western United States. A common explanation for this scarcity of early deposits is that a long period of erosion removed them in most localities. This scarcity may also be interpreted as showing that many mountains bearing evidence of Wisconsin glaciation were lifted into glacial snowline during the Pleistocene. In about half of the areas for which there are data the summits stand barely above to little more than 2,000 feet above glacial snowline as determined from elevations of lower cirque floors. Uplift was probably 2,000

feet on the average. Mountain areas that extended only a few hundred to 1,000 feet or so above snowline during the Wisconsin Stage almost certainly were below snowline during the earlier glaciations.—B.S.H.

Wallen, Donald A. *See* Pfleider, Eugene P. 8053

7896 **Walton, John.** Thore Gustaf Halle [d. 1964]: Royal Soc. Edinburgh Year Book, sess. 1964–65, p. 20–22, 1966.

Wares, R. *See* Leahy, E. J. 8200

7873 **Warner, Mont M.** Sedimentational analysis of the Duchesne River Formation, Uinta Basin, Utah: Geol. Soc. America Bull., v. 77, no. 9, p. 945–957, illus., 1966.

Twenty sedimentational entities were subjected to mathematical analysis through use of the sensitivity index (the quotient of the ratio of largest to smallest values). Map patterns of many of these entities reveal that two source areas in the Uinta Mountains provided sediments during Duchesne River time, that an initial subaqueous environment changed to subaerial conditions, and that there was a progression of uplift and relief in the general source area from west to east. Textural patterns of deposition, drawn from logarithmic plots of coarsest 1 percentile grain size C and median grain size M, are very useful as a preliminary survey. They reveal textural properties and variations within a formation to point to profitable areas of further research, such as provenance, transportation directions, and facies.—H.C.W.

7995 **Watson, Geoffrey S.** The statistics of orientation data: Jour. Geology, v. 74, no. 5, pt. 2, p. 786–797, illus., tables, 1966.

This paper provides the key references for, and a summary of, statistical methods for describing and analyzing orientation data. Most of the paper is concerned with the author's approximate analysis of variance procedures for unit vectors in two and three dimensions. The procedures are based on probability density proportional to ($\kappa \cos \theta$), where κ is an accuracy parameter and θ is the angle between the true and the observed directions. A brief account of the theory for exp ($\kappa \cos^2 \theta$) and its generalization is given; this may be useful for axial data.—Author's abstract

7918 **Wayne, William J.** Ice and land–A review of the Tertiary and Pleistocene history of Indiana, *in* Natural features of Indiana—Symposium, 1966 (Indiana Sesquicentennial Volume, 1816–1966): Indianapolis, Ind., Indiana Acad. Sci., p. 21–39, illus., 1966.

In the northern two thirds of Indiana virtually all the landscape has been determined by glaciers which spread over the land at least three times during the Pleistocene Epoch, burying preglacial shale lowlands, trenched limestone plains, and sandstone-capped escarpments. Bedrock features are mixed with those of glacial deposition, outwash, and lake beds; loess blankets almost the entire unglaciated part of the State. Direct evidence of the Mesozoic physiographic history of Indiana is missing, but the Ohio River Formation in southern Indiana probably represents Tertiary deposition. The briefly described Pleistocene stratigraphy is summarized on a chart. Total thickness of the ice has been estimated at the margin at no less than 400 feet, thickening abruptly northward to about 1,700 feet, 28 miles from the edge.—G.D.C.

7929 **Wayne, William J.** The reversal of Raccoon Creek at Atherton Island, west-central Indiana: Indiana Acad. Sci. Proc. 1965, v. 75, p. 167–174, illus., 1966.

None of the existing hypotheses for deflection of Raccoon Creek northward, around the east side of Atherton Island, have seemed wholly convincing. Field data suggest that two hypotheses, Dryer's ice dam and Tucker's outwash barrier, may be partly valid, but that sub-ice crustal depression was of major importance. Distribution of sediments suggests that fill in the lower valley is a large outwash plain and delta built into a proglacial lake when Wisconsin ice blocked the mouth of Raccoon Creek. Terrace altitudes suggest that crustal depression was about 60 feet. After the ice melted far enough westward to open the outlet north of Mecca, lake overflow swept

through the gorge from Coxville northward. This drainage reversal continued to exist because postglacial rebound was slow enough to permit erosion to keep pace.—*from* Author's summary

8009 **Webb, William M.; Briggs, Louis I.** The use of principal component analysis to screen mineralogical data: Jour. Geology, v. 74, no. 5, pt. 2, p. 716–720, illus., 1966.

The multivariate statistical technique of principal component analysis can be of considerable aid to the mineralogist and petrologist in the preliminary screening of mineralogical chemical data. The processing of chemical analyses of biotites by principal component analysis revealed the properties of isomorphous or atomic substitution, paired or coupled substitution, and other relationships among the chemical elements. Common mineral contaminants can also be discovered and removed from the chemical data. The use of principal component analysis is advocated as a preliminary screening device to point out subtle relationships of mineralogical significance that should have a basis in petrological theory.—Authors' abstract

7815 **Wegweiser, Arthur Erwin.** Ecology and distribution of some Foraminifera from shallow waters on the continental shelf of the northeastern United States [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, p. 532B, 1966.

Weimer, Robert J. *See* Hoyt, John H. 7943

8187 **Weimer, Robert J.** Time-stratigraphic analysis and petroleum accumulations, Patrick Draw field, Sweetwater County, Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 10, p. 2150–2175, illus., table, 1966.

The principal productive interval consists of two porous and permeable, north trending, barrier-bar sandstone bodies at the top of the Almond Formation (Upper Cretaceous). They grade updip on the west into impermeable shale and sandstone that were deposited in a swamp and lagoonal environment. A second important productive interval is sandstone about 40 feet below the top of the Almond that was probably deposited as a tidal delta in a lagoon. An early trap was formed when the reservoir sandstone beds were warped over an east-plunging structural nose. When the present Wamsutter Arch was formed in post-early Eocene time, the old trap was opened and the petroleum spilled northward to be trapped at its present location.—W.C.C.

Weimer, Robert J. *See* Hoyt, John H. 8334

8338 **Weimer, Robert J.; Hoyt, John R.** Burrows of *Callianassa major* Say, geologic indicators of littoral and shallow neritic environments, *in* Pleistocene and Holocene sediments, Sapelo Island . . . —Geol. Soc. America SE Sec., Field Trip 1, 1966, Guidebook: Athens, Ga., Univ. Georgia Dept. Geology, 9 p., illus., reprinted 1966; originally published 1964.

Burrows of this marine malacostracan are important structures in sand beaches along the coast from Florida to North Carolina. Abundant burrows, whose physical characteristics are described, can be seen in the low littoral zone, and on offshore bars that are exposed at low tide. Detailed work in the area of Sapelo Island, Ga., indicates that *C. major* is confined to the high-energy littoral and shallow neritic environments. Sandstone of Pleistocene age on bluffs in the area contains abundant structures identified as burrows made by *C. major*, indicating that it was deposited in such an environment. Cretaceous sandstones in the Rocky Mtn. area contain burrows presumably made by *Callianassa* or similar organisms. These are confined to sandstone deposited in this same environment.—*from* Authors' abstract

Weismiller, R. A. *See* Ahlrichs, J. L. 7893

Wen, W. W. *See* Smith, R. W. 8085

Wermund, E. G. *See* Selig, Franz. 8236

7892 **West, Terry R.; Johnson, Robert B.** Analysis of textural and physical factors contributing to the abrasion resistance of some Indiana carbonate aggregates: Indiana Acad. Sci. Proc. 1965, v. 75, p. 153–162, illus., 1966.

Textural data on Indiana carbonate aggregates were obtained by hand specimen examination, and from polished- and thin-section analysis. Engineering tests were run principally on the Los Angeles abrasion machine, and a multiple regression and correlation analysis was made on the resulting data. A cluster diagram of simple correlation coefficients is given for each of the four different statistical analyses made. Significant parameters are insoluble residues, void content, degradation value, average grain diameter, and sodium sulfate loss.—E.S.L.

West, Walter S. *See* Cohee, George V. 7777

White, Donald E. *See* Schoen, Robert. 8135

White, Joe L. *See* Ledoux, Robert L. 8136

8215 **White, W. Arthur; Bremser, Shirley M.** Effects of a soap, a detergent, and a water softener on the plasticity of earth materials: Illinois Geol. Survey Environmental Geology Notes, no. 12, 15 p., illus., tables, 1966.

Terms applied to plastic properties of clays are defined. Samples of clays tested in the laboratory showed changes in plasticity after additions of various amounts of soap, detergent, and water softener. Earth deposits saturated with effluent from septic tank fields or other waste-disposal facilities may become sensitive and move as creep or landslides when disturbed by vibrations. Where montmorillonite is present, the effluent may increase swelling.—E.S.L.

8052 **White, Walter S.; Wright, James C.** Sulfide-mineral zoning in the basal Nonesuch Shale, northern Michigan: Econ. Geology, v. 61, no. 7, p. 1171–1190, illus., table, geol. map, 1966.

Pyrite is the characteristic sulfide mineral throughout most of the Nonesuch Shale, which is 400 to 600 feet thick. In a zone 1 to 50 feet thick at the base of the formation, the dominant sulfide is chalcocite. The top of this cupriferous zone is marked by the upward mineral sequence chalcocite–bornite–chalcopyrite–pyrite. The boundary between the zones transgresses stratigraphy, and has the geometry of a simple, rather smooth envelope. Its regional configuration suggests that the copper is not syngenetic, but that it is related instead to a zone of wedging in the underlying Copper Harbor Conglomerate. Copper, introduced from below, may have replaced syngenetic iron-sulfide.—W.S.W.

7961 **Whitten, E. H. Timothy.** Structural geology of folded rocks: Chicago, Ill., Rand McNally and Co., 663 p., illus., tables, 1966.

The scattered literature on the geometry of folded rocks and associated minor structures is synthesized in a format suitable for senior undergraduate and graduate student teaching. The importance of the quantitative nature and three-dimensional variability of natural features and limitations of present information and knowledge are recognized. The 16 chapters include: recording and presentation techniques, cylindroidal folds, sampling and size in data collection, S-structures, symmetry concepts, simple types of folds, transpositional structures, foliation, linear structures, superposed folds, microtextures, sedimentary characteristics preserved in folded and metamorphic rocks, models and new methods for quantitative descriptions, review of terminology, and references. Many examples are drawn from metamorphic terrains.—G.D.C.

8013 **Whitten, E. H. Timothy.** Sequential multivariate regression methods and scalars in the study of fold-geometry variability: Jour. Geology, v. 74, no. 5, pt. 2, p. 744–763, illus., tables, 1966.

Quantitative descriptions of the location, orientation, and style of folds are based on scalar attributes rather than on the usual vectoral and qualitative data. These scalars are used (a) to map the areal variability of fold geometry and (b) as a basis

for sequential multivariate regression analyses in a search for those geological factors that control the nature and variability of folds in sedimentary or metamorphic rocks.—Author's abstract

7894 **Wier, Charles E.; Patton, John B.** Mineral resources, *in* Natural features of Indiana—Symposium, 1966 (Indiana Sesquicentennial Volume, 1816–1966): Indianapolis, Ind., Indiana Acad. Sci., p. 131–155, illus., tables, 1966.

Paleozoic formations above the Cambrian in Indiana have produced oil and gas, clay and shale, and construction materials; in addition there has been Mississippian gypsum and anhydrite, Pennsylvanian coal, and Quaternary gravel, peat, marl, and clay. Bituminous coal beds of the Illinois Basin underlying one-fifth of the State crop out in southwestern Indiana, which ranks 14th among the states in reserves and 7th in annual production. About 370 million bbls of petroleum have been produced since 1889, first from the east-central Trenton field and later from younger southwestern formations. The supply of industrial minerals and construction materials is nearly inexhaustible; the State leads in the production of building stone. Metals, scattered in water-sorted glacial material, are of little commercial importance.—G.D.C.

7979 **Williams, Sidney A.** The significance of habit and morphology of wulfenite: Am. Mineralogist, v. 51, no. 7, p. 1212–1217, illus., tables, 1966.

Morphological, cell-dimensional, microscopic, and minor-element data (Cr, As, V, W) are collected for various samples of wulfenite. The samples are assumed to have formed under near-surface conditions and the Eh and pH values assumed from the associated minerals (cerussite, willemite, mimetite, hemimorphite, plattnerite). The various physical and chemical data are partially correlated.—E.Z.

8152 **Williams, T. E.** Permian fusulinidae of the Franklin Mountains, New Mexico-Texas: Jour. Paleontology, v. 40, no. 5, p. 1142–1156, illus., 1966.

Restudy of the Permian rocks of the Franklin Mountains supports a three-fold subdivision based on correlation with the Hueco Canyon Formation, Cerro Alto Limestone, and Alacran Mountain Formation in the Hueco Mountains, Texas. The Hueco Canyon and Alacran Mountain Formations of the Franklin Mountains contain distinctive assemblages of fusulinid species directly comparable to those in the type localities. The Cerro Alto Formation is apparently barren of fusulines. Both the Hueco Canyon and Cerro Alto Formations are wholly within the "zone of *Pseudoschwagerina*" as is such portion of the Alacran Mountain Formation as can be observed. The top of the formation is not exposed and the position of the Wolfcamp-Leonard boundary is indeterminate.—*from* Author's abstract

Williamson, William O. *See* Tressler, Richard E. 8123

7937 **Wilson, C. R.; Nichparenko, S.; Forbes, R. B.** Evidence of two sound channels in the polar atmosphere from infrasonic observations of the eruption of an Alaskan volcano: Nature, v. 211, no. 5045, p. 163–165, illus., tables, 1966.

Mount Redoubt in Alaska began to erupt on January 24, 1966, through a new fissure vent on the north ridge below the old crater. The chronology of the eruptive cycle through February 20, 1966, is outlined. During this period, six separate infrasonic events associated with the various eruptions were observed at College, Alaska; the strength of the signals was generally proportional to the height of the erupted cloud. These pressure waves were probably generated by the sudden ejection of large volumes of high-pressure gas, rather than by explosions such as those of Bezymyannyy and Agung. For all events there were two infrasonic arrivals, showing that the waves traveled by two different acoustic channels in the atmosphere. Lower limits for the energy of the eruptions are calculated at 6×10^{20} ergs for the February 9 eruption and 1.0×10^{22} ergs for that of january 25.–d.b.v.

Winchester, John W. *See* Crocket, James H. 8221

8167 **Winder, C. G.** Conodont zones and stratigraphic variability in Upper Devonian rocks, Ontario: Jour. Paleontology, v. 40, no. 6, p. 1275–1293, illus., 1966.

A 259 foot section of the Upper Devonian Kettle Point Formation in a cable-tool drilled well contains an almost complete section of the formation. Species of platform conodonts are found in a sequence which correlate with zones defined by Ziegler (1958, 1962) and indicate that almost the entire Upper Devonian section is present. Correlation with the standard Upper Devonian ammonoid zones is cited. The sequence is interpreted as representing deposition in a basin in which the water depth gradually increased.—*from* Author's abstract

Wing, Laurence A. *See* Canney, F. C. 8005

Winkler, Erhard M. *See* Schneider, George J. 7833

7843 **Winkler, Erhard M.** Airphoto positive lineaments in northwestern Indiana [abs.]: Indiana Acad. Sci. Proc. 1965, v. 75, p. 151, 1966.

Winslow, John D. *See* Broeker, Margaret E. 7958

Withers, D. W. *See* Geiger, K. W. 8220

7835 **Woodring, W. P.** *Chiodrillia squamosa*, a Miocene turrid gastropod from the Dominican Republic: Jour. Paleontology, v. 40, no. 5, p. 1229–1232, illus., 1966.

This new genus for *Turris (Drillia) squamosa* Gabb has muricid-like submicroscopic sculpture, unusual in clavine turrids. It occurs in the Gurabo Formation.—R.E.G.

Wright, James C. *See* White, Walter S. 8052

Wright, Joseph Y. *See* Keys, David A. 8075

7810 **Wroblewski, E. F.** Big potential keeps drillers busy in the Anadarko basin: Oil and Gas Jour., v. 64, no. 44, p. 122–124, 1966.

Established reserves and known structures indicate a pre-Mississippian Anadarko basin potential of 50 trillion cubic feet of gas and more than one billion barrels of condensate. Wells reach the promising formations—the Hunton, Simpson, and Arbuckle—at depths exceeding 15,000 feet. The condensate and gas accumulations are controlled by pre-Pennsylvanian folding and faulting. Of nine wildcats so far drilled into the pre-Mississippian strata, seven are producers.—K.A.D.

8216 **Wuensch, B. J.; Nowacki, W.** The substructure of the sulfosalt jordanite [with German abs.]: Schweizer. Mineralog. u. Petrog. Mitt., v. 46, no. 1, p. 89–96, illus., tables, 1966.

Jordanite is one of at least ten intermediate phases in the system PbS–As_2S_3. The substructure was deduced, using similarity in the lattice dimensions with those of PbS, and the superperiod of strong reflections with both *h* and *l* even. The structure is based on a $2\times10\times2$ array of octahedra with 41115 11 11b_0. The exact chemical composition possibly is $Pb_{26}As_{14}S_{46}$. The substructure explains the striking oriented overgrowths of jordanite (010) on (111) of sphalerite.—*from* Authors' abstract

7971 **Jagi, Kenzo.** The system acmite-diopside and its bearing on the stability relations of natural pyroxenes of the acmite-hedenbergite-diopside series: Am. Mineralogist, v. 51, no. 7, p. 976–1000, illus., tables, 1966.

Phase-equilibrium relations have been studied at 1 atm. At lower temperatures there is a complete series of solid solutions between the two end members, but at higher temperatures acmitic pyroxenes melt incongruently to hematite and liquid. The low Po_2 in volcanic rocks favors the crystallization of Ca-rich pyroxenes of diopside-hedenbergite series, whereas the high Po_2 in pegmatites or related rocks favors the crystallization of acmite-rich pyroxenes or nearly pure acmite. It seems likely, therefore, that there are continuous solid solutions in the pyroxene system acmite-hedenbergite-diopside.—*from* Author's abstract

Yund, Richard A. *See* Hall, H. T. 8018

7814 **Zachary, Alvin Leslie.** Mineralogical and chemical study of the genesis of Miami, Russell, and Avonburg soils [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 27, no. 2, 558B, 1966.

Zeller, E. J. *See* Vaz, J. E. 7947

7770 **Zen, E-an.** Stockbridge Formation, Walloomsac Formation, Egremont Phyllite, Everett Formation, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey 1965: U.S. Geol. Survey Bull. 1244-A, p. A30–A30–A32, 1966.

7989 **Zenger, Donald H.** Redefinition of the Herkimer Sandstone (Middle Silurian), New York: Geol. Soc. America Bull., v. 77, no. 10, p. 1159–1165, illus., tables, 1966.

Stratigraphic usage of the "Herkimer Sandstone," the uppermost Clinton unit in east-central New York, has been inconsistent. In this revision the Herkimer is considered a formation with western and eastern lithofacies, each of which is called a member. The Joslin Hill Member, consisting of shale, dolostone, sandstone, and hematitic beds, represents the Herkimer Formation in the western part of the outcrop belt (Oneida, Rome, and Utica quadrangles). In the vicinity of Ilion Gorge the Herkimer undergoes an eastward change into an orthoquartzite for which the name Jordanville Member is proposed.—Author's abstract

7860 **Ziegler, A. M.; Boucot, A. J.; Sheldon, R. P.** Silurian pentameroid brachiopods preserved in position of growth: Jour. Paleontology, v. 40, no. 5, p. 1032–1036, illus., 1966.

Articulated specimens of *Pentamerus oblongus* and *Stricklandia lens* occurs in a vertical position, umbones down, in blocks collected from a bed of late Llandovery age [Red Mountain Formation] in Alabama and from the Lower Llandovery of Scotland, respectively. These brachiopods are in their original position of growth, as indicated by growth irregularities in many specimens caused by proximity to their neighbors. Ample attachment surface was available in the form of disarticulated valves which are preserved just beneath the umbones of the specimens; the delthyria of these pentameroids are covered in such a way by the umbones of the brachial valves that it seems likely that their pedicles atrophied during ontogeny.—Authors' abstract

8339 **Zimmerman, Everett A.** Basic water data report no. 2—Western and southern parts of Judith Basin, Montana: Montana Bur. Mines and Geology Bull. 50-B, 40 p., tables, 1966.

This section, Part B, contains the data upon which the interpretative report, Part A, is based. Statistical information tabulated includes water levels in observation wells, logs of wells and test holes, wells and springs, and temperature and specific conductance of water from wells and springs.—E.S.L.

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